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UNITED STATES AIR FORCE

AIR UNIVERSITY

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Wright-Patterson Air Force Base, Ohio

(3) LEVEL II

THE EFFECTS OF JOB ENRICHMENT AND GROUP/INDIVIDUAL TASK STRUCTURE ON PRODUCTIVITY, QUALITY, AND JOB SATISFACTION: A LABORATORY EXPERIMENT

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LSSR 24-78B

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER LSSR 24-78B	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) THE EFFECTS OF JOB ENRICHMENT AND GROUP/INDIVIDUAL TASK STRUCTURE ON PRODUCTIVITY, QUALITY, AND JOB SATISFACTION: A LABORATORY EXPERIMENT		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jeffrey A. Cameron, Captain, USAF Richard I. Moore, Captain, USAF		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Graduate Education Division School of Systems and Logistics Air Force Institute of Technology, WPAFB OH		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of Research and Administrative Management AFIT/LSGR, WPAFB OH 45433		12. REPORT DATE September 1978 13. NUMBER OF PAGES 134
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited (AFR 190-17)

JOSEPH P. HIPPS, Major, USAF
Director of Information

SEP 20 1978

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Job Enrichment
Group/Individual Tasks
Productivity
Quality
Satisfaction

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

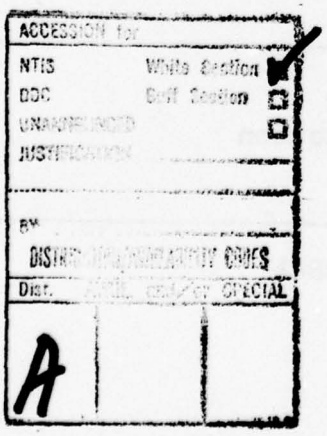
Thesis Chairman: Denis D. Umstot, Lt Col, USAF

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

In the face of the all-volunteer force and austere funding, two techniques the military uses to increase worker satisfaction are group task structure and/or job enrichment. This research attempted to determine the effect of enrichment and task structure on job satisfaction, productivity, and work quality. A 2x2 fixed effects matrix with enrichment (enriched/unenriched) and task structure (group/individual) combined to create four different work situations. Each of 122 individuals in the sample participated in construction of an Erector set model in one of the four work situations. Results confirmed that both enrichment and group task structure increased satisfaction. The results also indicate that the work situation that is most conducive to high productivity and quality is an individual unenriched task. The authors conclude that as long as management's interest is focused solely on optimizing productivity and quality, job enrichment and group task structure are not the best techniques to employ. However, when management examines the organization from a systems viewpoint, exactly the opposite may be true.



(14) AFIT-LSSR-24-78B

LSSR 24-78B

(6) THE EFFECTS OF JOB ENRICHMENT AND GROUP/INDIVIDUAL TASK STRUCTURE ON PRODUCTIVITY, QUALITY, AND JOB SATISFACTION: A LABORATORY EXPERIMENT.

(9) Master's thesis, A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

(12) 152 p.

By

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(11) September 1978

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012 250

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Captain Richard I. Moore

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN LOGISTICS MANAGEMENT

DATE: 8 September 1978

COMMITTEE CHAIRMAN

ACKNOWLEDGMENTS

We wish to express our appreciation to those who assisted us in the completion of this thesis.

Lt. Col. Denis D. Umstot, our advisor, was especially helpful in formulating the research design, revising rough drafts, and obtaining necessary support from outside agencies.

Colonel Henry Hansman, Associate Dean for Continuing Education, AFIT School of Systems and Logistics, authorized use of Continuing Education students as the sample for our research. Colonel Hansman's course directors were especially helpful by allowing us to conduct the two hour exercise during their already crowded course schedule.

The Air Force Office of Scientific Research funded procurement of the Erector sets used. Without financial assistance, the research could not have been accomplished.

Our wives, Lisa and Diane, provided invaluable encouragement and moral support throughout the entire year.

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INTRODUCTION

Since the introduction of Frederick W. Taylor's scientific management, the traditional criterion used to evaluate most job design experiments has been some form of work efficiency (Porter, Lawler, & Hackman, 1975). From a purely rational, technological perspective, a good case can be presented for the theory that more efficient jobs will lead to lower labor costs and increased overall organizational effectiveness (Porter et al., 1975). However, job design, when examined from an engineering viewpoint, ignores the impact of the job on the human being who must perform it. The assumption that the responses of people to their work can be programmed and controlled grossly underestimates several factors.

The attitudes of workers have changed since the introduction of scientific management.

> Those who actually produce goods and services in our economy no longer consider boredom, alienation, and lack of dignity as integral and necessary to their working lives. (Susman, 1976, p. 4)

Additionally, scientific management has failed to acknowledge the intensity of the reactions to simplified and routinized work. Absenteeism, turnover, sabotage, and labor disputes on all salient manifestations of worker dissatisfaction with their jobs, and the attendant costs are staggering. In the coal mining industry alone, wildcat strikes cost the miners 2.5 million man-days in 1977 (Time, 1978). In a business environment of ever advancing complexity, personnel recruiting and training costs represent substantial investments in employees. In conjunction with a high turnover rate, these substantial investments become substantial losses. The implication is that while in many instances scientific management techniques have brought immediate and visible returns in terms of increased output on the production line, there are hidden costs associated with their use. In addition to internal problems, companies are being forced by pressures from both foreign and domestic competitors to seek solutions to sagging productivity (Susman, 1976).

Just as with any other critical resource, employee motivation should be a key area of management concern. Management should recognize, however, that reapplication of traditional techniques will only intensify current labor problems (Susman, 1976).

The Military Setting

Budget cutbacks and austere funding underscore the need for optimal use of resources in the military. Since people fill the gaps between budget deficiencies and mission accomplishment, their welfare is a critical concern. As one Air Force General wrote,

> People are our most valuable resource and we must consider their needs and ambitions in our planning. Failure to do so increases the probability that we will be unsuccessful in attaining our objectives. (De Longa, 1970, p. 47)

The costs associated with the failure of the military in accomplishment of its mission are imponderable. Not every military job situation lends itself to job enrichment techniques (Gates, 1977), but selected studies have indicated that a well-designed program of job enrichment can serve to alleviate quality of life difficulties under appropriate circumstances.

Job Enrichment--An Answer?

One management technique that has gained popularity in the 1970's is job enrichment. To counter the worker's negative feelings brought on by strict applications of scientific management, job enrichment advocates suggest that the man should no longer be considered an adjunct to

the machine; human reactions to the job should be a primary consideration in the design of jobs. This is the aim of job enrichment. Job enrichment is defined as:

> The deliberate purposeful inclusion of, or increasing the amount of, such dimensions as variety, task identity, task significance, autonomy, and feedback so that the individual will experience a sense of meaningfulness and responsibility on the job. (Umstot, 1975, p. 14)

This definition is based on the Hackman and Oldham Job Diagnostic Survey which measures a number of job characteristics that affect motivation and satisfaction among workers (Hackman & Oldham, 1975).

According to Alderfer,

> Job enrichment, when properly undertaken and executed, must be considered a highly successful change strategy, benefiting both the individual and the organization. (p. 1628)

Problem Statement

Job enrichment techniques have been applied with varying degrees of success to many different organizational settings and tasks. As job enrichment efforts have spread, an increasing number of failures has raised serious questions about the continued viability of job enrichment as a tool for organizational change (Hackman, 1975). Wholesale application of job enrichment has not proved to be the best

approach. Not all individuals are motivated by work itself, nor can all tasks be enriched (Hackman, 1975). An understanding of the relationship between job enrichment and group/individual task structure is vital in determining the appropriate circumstances under which these techniques should be applied.

The impact of group task structure as opposed to individual task structure on productivity, quality, and job satisfaction is not understood. Tasks have been an important part of research on human behavior, and many of the differences in tasks and task characteristics have influenced the differences in individual and social behavior. In spite of the importance of tasks in behavioral research, the study of group vs. individual task structure remains mostly uncharted (Hackman, 1969).

Job enrichment's full potential for maximizing return on human resources cannot be realized unless its theoretical foundations are understood. Although largely under-investigated, tasks represent an important class of situational variables that are necessary for the understanding of individual and social behavior (Hackman, 1969).

The problem for research, then, is to investigate the effects of job enrichment and group/individual task structure on productivity, quality, and job satisfaction.

Justification for Research

As indicated by the Air Force's extensive endeavors in the Air Force Logistics Command (Herzberg & Rafalko, 1975) and other commands such as the Tactical Air Command and the Strategic Air Command (Gates, 1977), job enrichment is an important management strategy. While traditional work improvement efforts have concentrated on extrinsic factors such as pay, security, and working conditions, they have bypassed the intrinsic values of achievement, growth, and recognition that are key elements of job satisfaction and performance as viewed by the "men in the trenches" (Gates, 1977, p. 63). Only recently have these values come to the forefront through the use of job enrichment strategies.

When the issues of job design and problem solving are studied, few decision-makers are aware of the importance that group dynamics plays in the situation. Unfortunately, little is known about why some groups are more effective than others or why the few general findings which have

emerged from the literature do not encourage use of groups for important tasks (Hackman & Morris, 1974).

The interaction of workers in a group setting as opposed to individuals working alone is a critical concern to the manager as he designs his work situations to maximize performance and worker satisfaction. He must be aware of the potential values to be gained or lost as a result of the inevitable and ubiquitous presence of both formal and informal groups in any activity. A correct understanding of group dynamics permits the manager to deliberately enhance the desirable consequences from groups (Cartwright & Zander, 1968). The message, then, is clear. Knowledge of these issues is of paramount importance in determining the benefits to be achieved as a result of well-designed job enrichment efforts.

Objectives

The primary objective of this study was to determine, through laboratory experimentation, if there was a significant difference in satisfaction, quality, and productivity between people working in groups and people working individually on jobs.

A second objective was to determine the strength of the relationships in satisfaction, quality, and productivity between groups working in a high enrichment condition and those working in a low enrichment condition.

The third objective was to determine the relationships in satisfaction, quality, and productivity between individuals working in a high enrichment condition and those working in a low enrichment condition.

Research Hypotheses

Fifteen hypotheses were tested in this study. To facilitate the understanding of the hypotheses and their relationship to the objectives, they are divided as follows:

1. Hypotheses concerned with quality:

    a. Groups working on enriched tasks will produce higher quality output than groups working on unenriched tasks.

    b. Individuals working on enriched tasks will produce higher quality output than individuals working on unenriched tasks.

    c. Groups working on unenriched tasks will produce higher quality output than individuals working on unenriched tasks.

    d. Groups working on enriched tasks will produce higher quality output than individuals working on unenriched tasks.

e. Individuals working on enriched tasks will produce higher quality output than groups working on unenriched tasks.

2. Hypotheses concerned with productivity:

   a. Groups working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

   b. Individuals working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

   c. Groups working on unenriched tasks will have greater productivity than individuals working on unenriched tasks.

   d. Groups working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

   e. Individuals working on enriched tasks will have greater productivity than groups working on unenriched tasks.

3. Hypotheses concerned with job satisfaction:

   a. Groups working on enriched tasks will have a higher level of satisfaction than groups working on unenriched tasks.

   b. Individuals working on enriched tasks will have a higher level of satisfaction than individuals working on unenriched tasks.

   c. Groups working on unenriched tasks will have a higher level of satisfaction than individuals working on unenriched tasks.

   e. Individuals working on enriched tasks will have a higher level of satisfaction than groups working on unenriched tasks.

The overall thrust of the study was to show whether group task structure would result in higher levels of quality, productivity, and job satisfaction, and whether high enrichment conditions would have similar effects.

Research Questions

In addition to the above hypotheses, the following research questions were addressed by this study:

1. Will groups working on enriched tasks produce higher quality output than individuals working on enriched tasks?
2. Will groups working on enriched tasks have greater productivity than individuals working on enriched tasks?
3. Will groups working on enriched tasks have a higher level of job satisfaction than individuals working on enriched tasks?

These research questions were derived from a study of the literature which indicated that little, if any, data were available in support of either groups or individuals with regard to the three questions. This research project was designed to provide that data.

Summary

This chapter sets the stage for the research effort by discussing some current problems encountered by management

with respect to employee satisfaction as related to job design. An alternative management strategy--job enrichment--is offered as a possible solution to alleviate quality of life problems in the workplace. The problem statement and justification for research then identify the need for understanding the relationship between job enrichment and group/individual task structure. The chapter concludes with a statement of the hypotheses and research questions that formed the basis for this research effort. Chapter 2 reviews the pertinent literature in order to place the research in its proper context.

Chapter 2

LITERATURE REVIEW

This chapter provides a literature review that places the research in the proper context. Past research was examined to ascertain the effects of enrichment efforts and task structure (group vs. individual) on job satisfaction, productivity, and quality, including the bases for the hypotheses and research questions.

The Impact of Job Enrichment on the Worker

In practice, job enrichment techniques seek to increase satisfaction by giving the employee a greater chance for personal achievement, recognition, and advancement while providing him with more challenging and responsible work (Paul, Robertson, & Herzberg, 1972). Research indicated that many prominent behavioral scientists maintained initially that such techniques would lead to higher levels of motivation, satisfaction, and productivity among workers involved (Horstman & Kotzun, 1977). However, after early successes in job enrichment implementation, it became

apparent that there were serious problems inherent in the method of employment (Hackman, 1975).

Studies conducted by Paul, Robertson, and Herzberg (1969) on the effects of job enrichment had some interesting findings. Enrichment efforts make it possible for the worker to raise his level of performance and achievement by giving him the opportunities to do so while at the same time giving him little reason to achieve less. While not all employees welcome job enrichment efforts, as long as "the changes are opportunities rather than demands, there is no reason to fear an adverse reaction" (Paul et al., 1969, p. 261).

Job enrichment efforts at the Saab-Scania and Volvo automobile plants in the 1960s (Organ, 1978) resulted in increased flexibility in the plant, decreases in absenteeism, higher productivity, and improved quality, although exact degrees cannot be determined. In addition, these job enrichment programs resulted in improved employee attitudes.

Herzberg (1968) indicated that job enrichment is not a one-time action, but a continuous one whose initial changes will last for a long time, because the long-term nature of motivators tends to have a positive effect on employees' attitudes. Those workers with exceptional

ability are better able to demonstrate their expertise and consequently gain promotion to higher level jobs. Also, the changes bring the job up to the challenge level commensurate with the skill that was required.

As Herzberg sums up nicely (1968, p. 169):

> The argument for job enrichment can be summed up quite simply: If you have someone on a job, use him. If you can't use him on the job, get rid of him . . . If you can't use him and you can't get rid of him, you will have a motivation problem.

In summary, job enrichment has been shown to have a positive influence on employee satisfaction. Unfortunately, due to misapplication, job enrichment efforts have not been universally successful. Additionally, job enrichment programs are not always welcomed by the workers. However, when a job enrichment program is correctly applied, the results are most gratifying. Job enrichment has been credited with reduction in absenteeism and turnover, and with increasing satisfaction, productivity, and quality of output.

Enrichment and Job Satisfaction

According to Locke, job satisfaction may be defined as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" (1976, p. 1300).

Attributes such as opportunity to use skills and abilities, creativity, variety, responsibility, autonomy, and opportunity for new learning were found to be directly related to work interest and satisfaction, and the common element, mental challenge, is the key to satisfaction (Locke, 1976). Absence of adequate mental challenge or presence of an automatic, boring work task can lead to a definite lack of job satisfaction. Conversely, too much of the above attributes can also decrease worker satisfaction if the individual cannot cope with his situation. Therefore, research indicates that work which is varied, allows autonomy, is not too physically demanding, is mentally challenging and yet allows the worker to be successful, and is personally interesting will be satisfying to the worker on the job (Locke, 1976). Job satisfaction is perhaps the most direct and immediate gain to be achieved in enrichment efforts, and workers who are satisfied with their jobs and job-related activities have feelings that can lead to greater involvement, commitment, and more effective job performance (Hackman & Suttle, 1977).

At the same time, many theorists dispute the positive correlation between satisfaction and performance, and state that most of the literature sources "lack any

unambiguous declaration that increased satisfaction leads to increased performance" (Organ, 1978, p. 134). Roethlisberger noted that the factors which lead to efficiency in an organization are not necessarily the same ones that make for happiness, morale, and teamwork (Schwab & Cummings, 1975).

While opposing viewpoints abound, the fact remains that the relationship between worker satisfaction, productivity, and the overall quality of worklife is still fertile ground for research.

Enrichment and Productivity

The number one business problem today in the area of personnel relations lies in discovering how to increase productivity (Sibson, 1976). Productivity deserves the attention that it has received, for it is a measure of the efficiency with which resources are converted into the products and services that men want. Higher or lower productivity affects costs, prices, profits, output, employment, and investment, and thus plays a part in business fluctuations, in inflation, and in the rise and decline of industries (Kendrick, 1961).

There is little doubt that workers in America are operating far below their potential in terms of productivity. Often workers are engaged in counterproductive practices. Poor quality work, informal production limits, and wasted time are among but a few of the symptoms of less than optimal productivity (Sibson, 1976). Sibson viewed the combination of lowered productivity by U.S. workers and increasing competition in the international marketplace as factors contributing to an economic crisis of catastrophic proportions in the 1980's. Although few authors will go as far as predicting a depression, many support the idea that increasing productivity is a key issue facing today's management (Susman, 1976; Glaser, 1976; Kast & Rosenzweig, 1974).

Three classes of variables dictate how well an individual or group will perform a task: task demands, resources, and process (Steiner, 1972). Task demands include the requirements imposed on the individual or group by the task itself, or by the rules under which the task must be performed. Resources include all the relevant knowledge, abilities, skill, or tools possessed by the group or individual who is attempting to perform the task (Steiner, 1972).

Even when the resources of the workers are matched perfectly with the task demands, the output is generally below the potential productivity of the group. This diminished output productivity is a result of process. Steiner defines process as the actual steps taken by an individual or group when confronted by a task (1972).

As previously discussed, the marginal utility of simplifying task demands to increase productivity has decreased in recent years. There is little an organization can do to increase the resources involved in enhancing productivity. Consequently, management has begun to focus on the process variables, including intrinsic values of achievement, growth, and recognition that are key elements of job satisfaction (Gates, 1977). Through the use of job enrichment efforts, managers and researchers have sought the answer to increased productivity as a result of increased worker satisfaction. Initially, much of the interest in job enrichment was based on the belief that job satisfaction led to higher productivity. This view has now been discredited and most psychologists do not feel that satisfaction increases productivity (Lawler, 1973). There is little in the literature that suggests a causal relationship between satisfaction and productivity. If anything,

both drive theory and expectancy theory would seem to predict that high satisfaction might reduce motivation because of a consequent reduction in the importance of various rewards that may have provided motivational force (Lawler, 1973).

Enrichment and Quality

A review of the literature revealed several examples of increased quality levels that were attributed to job enrichment. Ford (1973) reported reduced error rates among a group of typists at American Telephone and Telegraph. In another study, the collective error rate of 98 keypunch operators and verifers went from 1.53 percent before job enrichment to 0.99 percent after job enrichment efforts (Hackman et al., 1975). The editors of Organizational Dynamics reported a similar increase in quality levels at a Volvo plant after job enrichment efforts there (Organ, 1978).

Increased worker satisfaction with their jobs is a byproduct of higher quality levels. Most workers take pride in producing quality products while working with a company which cultivates high quality standards (Kast & Rosenzweig, 1974).

In summary, increased quality levels have been evident in several applications of job enrichment. Numerous studies have been conducted, with generally positive results, and most indications still are favorable toward job enrichment's utility relative to increased quality.

Group vs. Individual Performance

Group dynamics as an identifiable field became important to the social scientist in the United States around the 1930's. Since then, numerous studies and experiments have been conducted to determine exactly what happens to individuals when they are placed in a work environment with others and directed to solve problems with the group (Cartwright & Zander, 1968).

Managers seem to be preoccupied with the thought of group solutions and discussions and believe that "everything should be done by and in groups . . . the only good things are committee meetings, group decisions, group therapy, group think, and togetherness" (Cartwright & Zander, 1968, p. 23). The fact is that "existing evidence strongly suggests that . . . output of interacting groups generally is poorer than that which would be obtained by

pooling the output of individuals acting independently" (Hackman et al., 1974, p. 1). This has been the focus of study for many social scientists. While something in group interaction occurs that affects the performance and satisfaction of the group, little is known about exactly what that something is, or how task structure and job enrichment can affect the group (Hackman & Morris, 1974). A study by Hackman, Weiss, and Brousseau (1974) indicated that benefits can be achieved in group performance effectiveness studies by means of an approach involving the experimental creation of non-traditional patterns of behavior in groups. Groups that were artifically forced into interdependent action and coordination (greater job enrichment) displayed higher levels of production and more satisfaction with the task and with each other than did the groups that were left to their own devices (low job enrichment). This point suggests that groups can be induced to attain higher levels of job satisfaction and performance if the proper techniques are developed and implemented (Hackman et al., 1974).

According to Hare (1976), the group problem-solving sequence involves the three stages of definition, discussion, and working-through. Since these stages require interdependence among group members, each member "must re-examine

his view of the problem in the light of the views of the group, a process involving tension and requiring opportunity for interaction" (Hare, 1976, p. 308). Obviously the individual working independently on a task is not concerned with such interaction and is free to continue at his own initiative.

The influence of the group on the individual can profoundly affect thoughts, feelings and acts. The Hawthorne studies of the 1920's were indicative of the effects of group interaction and influence as opposed to individual performance (Kast & Rosenzweig, 1974). However, studies by Marquart in 1955 and Lorge, Fox, Davitz, and Brenner in 1958 showed that although the group is usually better at task performance than the average individual, it is seldom better than the best individual (Hare, 1976), although much of the improved performance can be attributed to the problem solving skills of the individual. Additionally, some group success is based on the superior individual skills of one group member, although groups score higher on manual skills and individuals score higher on intellectual problems (Hare, 1976).

As previously stated, studies in job enrichment have shown that not all jobs can be enriched. Consequently,

the question of group vs. individual becomes paramount when considering task accomplishment methods. Horstman and Kotzun (1977) found evidence to support the use of the group approach for unenriched, dull tasks since workers exhibited higher levels of satisfaction when involved in the team framework for these situations. On the other hand, challenging, enriched tasks were more satisfying for the workers when individual effort was employed.

A review of the pertinent literature indicated no conclusive studies concerning the relationships between group vs. individual tasks as related to job enrichment, and the implication is that a study should be conducted to determine such relationships. A high level of enrichment in the task should result in a group norm encouraging high effort, while low enrichment in the task should result in the opposite effect (Hackman, 1976). A natural follow-on assumption would be that job satisfaction and productivity should react similarly. Ensuring that the analysis is conducted at the group level rather than the individual level (that is, design the task to require interdependence over independence) should also result in positive outcomes, provided that the individual group members "identify with and

feel personal commitment to the group as a whole" (Hackman, 1976, p. 16).

The problems associated with group vs. individual job design are complex and in many instances depend on factors idiosyncratic to a given situation (Hackman, 1976). The presence of others in a group condition has been found to stimulate some workers to greater productivity, distract others, and leave others unaffected (Hare, 1976). Much study has been conducted, but all indications are that more definitive experimentation is needed.

The Role of the Task in Job Enrichment Efforts

Tasks have been used in a variety of functions in research on human behavior; they pervade the methodologies of nearly every major area of behavioral research. Almost routinely, subjects are given a task to perform while some substantive variables are studied (Hackman, 1969).

Many definitions for the concept "task" have been proposed in the literature. Hare suggested that the task, in effect, is the whole situation, and that the aspects of the situation and task are so firmly intertwined that there is little utility in differentiating between the two (Hackman, 1969). Although there "is considerable merit

and potential elegance" in such a broad-based definition of task, "it may be more fruitful to deal separately with those more closely-defined aspects of the situation" (Hackman, 1969, p. 101). In this research effort, task will be defined operationally as follows:

> A task may be assigned to a person (or group) by an external agent or may be self-generated. It consists of a stimulus complex and a set of instructions which specify what is to be done vis a vis the stimuli. The instructions indicate what operations are to be performed by the subjects with respect to the stimuli and/or what goal is to be achieved. (Hackman, 1969, p. 112)

One factor that stands out in most forms of work is the dimension involving task dependencies. "Task dependencies may be categorized as either independent or interdependent" (Cummings & Srivastva, 1977, p. 89). Independent tasks are those that can be accomplished by individuals; interdependent tasks by their very nature require two or more people for accomplishment.

In spite of the importance of the task, Hackman observed that in most research situations the task itself is not central to the experimental treatment, and any task effects are frequently not accounted for by the study design. He goes on to suggest "that tasks to be used in behavioral research should no longer be considered merely 'something

for the subject to do' while other phenomena are being studied" (Hackman, 1969, p. 122).

Since 1969, Hackman has conducted several studies which consider the task in their experimental design and treatment. Hackman and Vidmar (1970) examined task type, group performance, and member reactions. They concluded that the type of task strongly affected both performance characteristics and member reactions. In a later study, Hackman examined the interaction of task design and group performance strategies in determining group effectiveness (Hackman et al., 1974). This study showed that explicit discussion of group performance strategy improved productivity, but only when the task required coordination and sharing of ideas. In the case of a simple task, a group strategy proved to be counterproductive (Hackman et al., 1974). Tasks have been studied as potential sources for motivation in job enrichment efforts. Steers and Porter (1975) classified the nature of job attributes on characteristics, the task, as "a major concern" in the development of a comprehensive theory of motivation at work. They indicated that variations in the nature of the task itself can influence performance and satisfaction.

The task is a central concern in the field of job enrichment. Much research has been done on job enrichment, yet the impact of individual and group task structure on the success of job enrichment remains largely uncharted.

Summary

This chapter reviewed relevant literature in an effort to place the research in the proper context. In general, the literature has shown that job enrichment programs can have a positive effect on worker satisfaction. Little support was found for the contention that productivity is increased by job enrichment. In contrast, quality levels appear to be enhanced by job enrichment.

The literature concerning group vs. individual task structure suggests that choices for designing work for individuals or for groups are complex, and in many cases depend on factors peculiar to the given situation (Hackman, 1976). The question of whether group or individual task structure is superior was not conclusively answered in the literature. Some tasks lend themselves to group structure, while others are better handled individually. Both structures are contingent upon many varying factors. Additional research in this area is needed.

Chapter 3

METHODOLOGY

This chapter will describe the methodology which was employed to determine the effects of the different experimental manipulations on productivity, quality, and task satisfaction. Included will be an overview of the research design, a definition of the sample population and the nature of the sample, a discussion of the variables and their measurement methods, and a brief description of the statistical techniques that were employed to analyze the data.

Research Design

Four experimental cells were utilized to determine the effects of job enrichment and task structure on the variables. A 2x2 fixed effects matrix involving enrichment (high or low) and task structure (individual or group) was employed as shown in Figure 1.

		Task Structure	
		Individual	Group
Enrichment	Unenriched	Individual Unenriched Task	Group Unenriched Task
	Enriched	Individual Enriched Task	Group Enriched Task

Figure 1

Research Design

After participating in the research tasks, the students completed the questionnaire shown in Appendices C and D, which was designed to measure the levels of satisfaction with the task, satisfaction with the experimenter, and degree of enrichment perceived while completing the experiment. Task performance was rated by visual inspection to determine quality and productivity, and the data base was then statistically analyzed as described later.

Population and Sample

Participants in the experiment were primarily middle-level managers enrolled in Continuing Education

classes at the Air Force Institute of Technology (AFIT). The sample consisted of 99 individuals enrolled in four Spring, 1978 AFIT Continuing Education classes, 14 individuals enrolled in Spring, 1977 AFIT Continuing Education classes, and 9 members of the AFIT School of Systems and Logistics Class 79A graduate program. The individuals from the 1977 Continuing Education classes were randomly selected from data previously compiled by Horstman and Kotzun (1977). To ensure statistical compatibility, t-tests were accomplished on the means and there was no significant difference ($\alpha = .05$) between the different data sets in MPS, quality, satisfaction, and productivity. Similar tests accomplished for the Class 79A graduate students also showed no significant differences between samples. With the exception of the 14 individuals from the 1977 Continuing Education classes, on whom the data were unavilable, the sample was analyzed to detect possible performance variations caused by the sex of the participants. Of the remaining 108 students, 20 were women. The random assignment of each individual to experimental cells was expected to eliminate any biasing of the results, and

except as noted later in the chapter, no significant differences were noted by the experimenters. Overall demographic data are shown in Table 1.

Participation in the experiment. The very nature of the sample used in this study limited any generalizations to higher levels concerning the results. The subjects had a somewhat higher specialization level as opposed to the composition of the average DOD work force group, and the differences among specialties (logistics vs. maintenance, for example) could have caused different reactions to the experimental situations, as well as affecting the performance. To counteract any systematic bias, assignment to experimental conditions was made randomly, without regard to rank, sex, specialty field, or any other distinguishing characteristic as shown in Table 2.

The classes utilized were chosen based on the compatibility of the course directors' curriculum with the schedules of the experimenters and their academic advisor, who conducted a short debriefing and job enrichment seminar after the experiment. Participation was strictly voluntary, and, with the exception of one person,

Table 1

Rank and Career Field Information on Participants in Laboratory Experiment

Rank	Procurement	Maintenance	Inventory Management	Finance	Other	Totals
Military Officer						
0-6 Colonel		1				1
0-5 Lt. Col.		1				1
0-4 Major	1	2				3
0-3 Captain	3	6			2	11
0-2 1st Lt.		1			2	3
0-1 2nd Lt.	3			2		5
Sub-Total	7	11	0	2	4	24
Military Enlisted						
E-7 Master Sgt.			1			1
E-6 Tech. Sgt.			1			1
Sub-Total	0	0	2	0	0	2

(continued)

Table 1 (continued)

Rank	Procurement	Maintenance	Inventory Management	Finance	Other	Totals
Civilian						
Contractor					5	5
GS-5			3		3	6
GS-7	1	1	4		2	8
GS-9	4		4	2	1	10
GS-11	14	6	6	3	7	36
GS-12	5	1	7	5	4	22
GS-13	1	1	1		2	5
GS-14		1			2	3
Sub-Total	25	10	25	10	21	96
Total	32	21	27	12	30	122

Table 2

Summary of Participants and Their Breakdown into Experimental Cells

Class Number	Description	Group Approach		Individual Approach		Totals
		Unenriched	Enriched	Unenriched	Enriched	
206D	Initial Provisioning	8	8	3	3	22
361D	Surveillance/CSC Systems	8	4	6	6	24
300C	Advanced Property Administration	8	8	7	6	29
220D	AFLC Materiel Management	8	12	2	2	24
79A	Graduate Logistics	-	-	-	9	9
77B	Misc. Continuing Education	-	-	14	-	14
TOTALS		32	32	32	26	122

all class members took part in the experiment. Total time, including the debriefing and seminar, was approximately two hours.

Advantages of sample. Although the heavy concentration of upper and middle level management in the sample could cause some bias, the random enrollment at AFIT of a cross section of many DOD agencies and commands as well as the random assignment to experimental cells was expected to counteract this bias. As in a similar study (Horstman & Kotzun, 1977), neither rank structure, past work history, nor personal preference was considered in the conduct of the experiment. The managerial experience and maturity of AFIT enrollees, as well as their obvious availability, made them an excellent sample. Additionally, Alderfer, Kaplan, and Smith (1974) pointed out that the usual experimental methodology of utilizing college freshmen and sophomores has its drawbacks due to the obvious differences in maturity and managerial experience of the subjects.

Experimental Design

The task. The four experimental conditions were tested by means of Erector set model assembly. The goal

of each experimental cell involved construction of a pre-specified model or component of a model. The group task was designed to necessitate cooperation and interaction among the group members to facilitate its completion. The level of enrichment was incorporated into the model design, and the experimenters served as work "supervisors," giving instructions, answering questions, and providing applicable feedback. Participants took part in one phase of the experiment only, and the phases were physically separated to prevent possible sample bias or contamination due to exposure to other situations.

The major task involved construction of an arctic radar tower model, complete with a battery-operated motor which turned the radar screen. The Enriched-group cell participants built the entire model, while the Unenriched-group cell participants built only the tower without the radar unit itself. The Individual-enriched cell members each built a working copy of the radar unit, and the Individual-unenriched cell participants built only small, repetitious components of the tower, such as base plates or tower support assemblies. Experimenter behavior and work environment were held as constant as possible by using the two scripts shown in Appendices A and B.

Motivating Potential Score (MPS). The Hackman and Oldham (1976) "Job Characteristics" model was the primary method of determining the degree of job enrichment in the experimental task design. The model consists of the following five core dimensions:

1. Skill Variety -- the degree to which a job requires a variety of different activities in carrying out the work, which involve the use of a number of different skills and talents.

2. Task Identity -- the degree to which a job requires completion of a whole and identifiable piece of work; that is, doing a job from start to finish with visible outcome.

3. Task Significance -- the degree to which a job has substantial impact on the lives or work of others.

4. Autonomy -- the degree to which a job provides freedom, independence, and discretion to the worker in scheduling the work and in determining the necessary procedures.

5. Feedback -- the degree to which carrying out the activities required by a job results in the worker receiving direct and clear information about his effectiveness.

Table 3 indicates manipulations used to influence each of the above core dimensions during the conduct of the experiment.

The variables can be numerically scored from one to seven, and a quantitative measurement of job enrichment,

Table 3

Summary of Experimental Manipulations Used to Induce High and Low Enrichment

Core Dimension	Manipulations: Enriched Task (Individual and Group)	Manipulations: Unenriched Task (Individual and Group)
Skill Variety	1. The tasks were designed to require several different types of connections and skills of varying complexity.	1. Participants were directed to build a particular component.
	2. Instructions emphasized the complexity of the task, e.g., "Although it seems simple, it has real world implications."	2. Instructions stressed the routine, boring nature of the task, e.g., "People of your grade-level will find it quite simple.

(continued)

Table 3 (continued)

Core Dimension	Manipulations: Enriched Task (Individual and Group)	Manipulations: Unenriched Task (Individual and Group)
Task Identity	1. Subjects completed a "whole," relatively complex model.	1. Participants built only simple components of a larger model.
	2. Instructions emphasized the "start to finish" aspect of the task and the fact that the individual or group was fully responsible for model quality.	2. Instructions emphasized the insignificance of the task in comparison to the whole model. Participants were held responsible only for their component but not for the entire assembly.
Task Significance	1. Instructions emphasized the unique nature and importance of the Erector set exercise. Participants were told of its applicability to their jobs as managers and to the solution of DOD motivational problems.	1. No information on the applicability potential of the Erector set task was given.

(continued)

Table 3 (continued)

Core Dimension	Manipulations: Enriched Task (Individual and Group)	Manipulations: Unenriched Task (Individual and Group)
Autonomy	1. Participants were given complete freedom to move around and take breaks as they desired.	1. Participants were asked to remain seated throughout the exercise.
	2. Participants were given complete freedom to design their own work strategies for model assembly.	2. Erector parts were pre-positioned on work tables. Participants were directed to build certain parts of the models.
Feedback	1. Participants could observe classmates and compare performances (Individual Enriched). They could also compare their model with completed example. They were able to see the final results of their work when the electric motor was switched on, turning the radar screen.	1. Experimenters made no comments on task quality, etc.
		2. Participants (Individual Unenriched) were asked to remain seated throughout. Work tables were arranged so as to make visual comparisons difficult. Individual Unenriched participants made different components, also making comparisons difficult.

called the Motivating Potential Score (MPS), can be obtained as specified by Hackman and Oldham (1976):

$$MPS = \left(\frac{\text{Skill Variety} + \text{Task Identity} + \text{Task Significance}}{3} \right) \times \text{Autonomy} \times \text{Feedback}$$

The higher the MPS, the higher the degree of job enrichment. An increase or a decrease in any of the core dimensions will result in a corresponding change in job enrichment (Hackman & Oldham, 1976).

Group size. The effect of size on a group's attractiveness and efficiency was a key concern in designing the task. The bulk of the research efforts have indicated that as group size increases, there is a corresponding decrease in job satisfaction, and an increase in absenteeism, turnover rate, and the like (Cartwright & Zander, 1968). Larger groups tend to be more highly competitive, and group members perceive themselves as being more inhibited in participating in problem solving and expressing their views (Hackman & Vidmar, 1970).

Steiner (1972) used the phrase "group process loss" to describe the effect of size on group actions, and he indicated that small groups of five or fewer members

were ideal for group problem solving. Since single members generally carry more weight in smaller groups, individuals tend to work harder in small groups than in large ones (Steiner, 1972). However, Steiner also pointed out that if the group is too small, group members may perceive that any efforts are futile due to lack of sufficient resources. Groups of three, four, or five may raise the probability of task completion to a level that justifies maximum effort, while larger numbers may lead to lack of coordination, decreased feelings of responsibility, and slackening of effort (Steiner, 1972).

Since the variables in this study, satisfaction with task, productivity, and quality, appear to be affected the most by large group size, the choice of group size was a key concern. The choice of four for group size was based on studies of small group interaction conducted by O'Dell (1968). He found that a group of four exhibited a higher rate of positive group interaction, showed least tension, both actual and perceived by group members, and exchanged the most information. Horstman and Kotzun (1977) found that groups of four people worked well with the Erector set task design. Groups of four were therefore considered ideal for this project.

Variables and Their Measurement

Five variables were introduced to measure the results of the experiment. The independent variables of enrichment (enriched vs. unenriched) and task structure (group vs. individual) correspond to the nature of work. The dependent variables of satisfaction with the task, productivity, and quality correspond to the outcomes of work. This section will discuss the variables and the measurement techniques used.

Independent variables. For experimental purposes, the independent variables used for the study were nominal level data; for example, job enrichment was either present or not present.

The degree of enrichment for purposes of manipulation checks was measured using the modified Job Diagnostic Survey (JDS) in Appendix C. The JDS was developed by Hackman and Oldham (1975), and measures the worker's perception of enrichment on the job. Tests have shown that the JDS is a reliable and valid measure of job enrichment (Hackman & Oldham, 1975).

The questionnaire was modified to ensure compatibility with the Erector set exercise by Horstman and

Kotzun (1977), and was administered in the same manner. Responses were scored on a 7-point Likert scale as shown in Appendix F. The averaged responses were used to calculate MPS scores in accordance with the Hackman and Oldham formula as a manipulations check to ensure that the tasks were achieving the desired effects. MPS has a range of 1 to 343 and is interval level data (Horstman & Kotzun, 1977).

Dependent variables. The dependent variables were measured using the methods developed by Horstman and Kotzun (1977) for a similar laboratory experiment. Satisfaction was measured using a modified version of two scales of the Job Descriptive Index (JDI) developed by Smith, Kendall, and Hulin (1969), and shown in Appendix D. This instrument was modified to correspond with the Erector set tasks, and measures both reaction to the task itself and to the experimenter (Horstman & Kotzun, 1977).

The JDI has been shown to be a valid and reliable measure of job satisfaction. Vroom described it as "the most carefully constructed measure of job satisfaction in existence today" (1964, p. 100). In addition, Horstman and Kotzun's research showed that the JDI was well-suited

to this type of experiment. Umstot (1975) indicated that the JDI's low level of abstraction makes it harder to guess what the experimenter wants.

The interval level data on satisfaction, both with the task and with the leader, were measured on a scale from 0 to 54. Scoring was accomplished using the weighting system specified by Smith, Kendall, and Hulin (1969). The combined questionnaire was administered immediately after the participants completed the Erector set exercise.

The remaining dependent variables, quality and productivity, were measured by means of observations by the experimenters, utilizing the scoring sheet in Appendix G.

Quality scores were measured on a one to five scale by independent observation of both experimenters, based on accuracy and tightness of nut and bolt connections. These subjective scores were entered under the applicable categories shown in Appendix G. Since all the categories did not apply to each of the experimental models, compatibility was achieved by computing a percentage score based on the number of points achieved divided by the total points available for the particular model. This method resulted in interval level data with a range of zero to one.

Productivity scores were calculated by dividing the number of nut and bolt connections by the number of minutes taken to complete the task, resulting in ratio level data of connections per minute with a range from zero to an unspecified upper limit.

Incompatibility of group and individual scores. Since the group productivity scores (both enriched and unenriched) consisted of the combined efforts of four individuals working together, a basic incompatibility existed between the group and individual data in terms of statistical analysis. To remedy this situation, one of two approaches had to be taken: either convert the group scores to terms of output per individual, or group the individual scores by randomly assigning individuals into groups. There are inherent advantages and disadvantages to each technique.

One major advantage of converting the group data to output per individual is that no scores are lost. Another advantage is that the number of scores in each of the four cells is closer to being equal. Additionally, more statistical leverage can be applied due to an increased sample size.

A disadvantage of dividing the group output into output per individual is that this averaging of the total output reduces the variance within the group cells. Although this reduced variance is desirable, it is artificially introduced into the sample data.

The technique of placing individual scores randomly into groups of four shares the advantage of nearly equal cell sizes for analysis. However, with this technique some of the sample data are by necessity lost. Another disadvantage of grouping scores is the possibility of significant bias, even when scores are randomly assigned. Ideally, one would have a computer program which could randomly assign individuals to groups and arrive at a group score. Then, statistical analysis could be cycled several thousand times to determine an average level of significance of the treatment effects. Such an analysis was beyond the scope of this study. The method decided upon was to calculate an average productivity score for each group member and use this score for all data analysis.

Control of Extraneous Variables

As previously stated, every attempt was made to avoid any possible biasing or contamination of the

participants during the conduct of the experiment. However, as a previous study illustrated (Horstman & Kotzun, 1977), the possibility of unexpected bias always exists.

Manual skill superiority. While the possibility exists that some groups or individuals may perform better due to differences in the individual finger dexterity of the subject, the use of a "simple mechanical device" as described by Hackman and Morris (1974) should have eliminated most bias involved with this phenomenon. Horstman and Kotzun found that the chances for such biasing efforts were minimal. However, some of the female participants in the present study experienced difficulty in making the nut and bolt connections due to their long fingernails. Two other subjects in the Individual-enriched cell simply could not complete the task, and were eliminated from the analysis. Additionally, one subject in the Individual-enriched cell was an amputee who still desired to take part in the experiment. While he was successful in completing the task, his performance data was eliminated from analysis.

Learning curve effect. Learning Curve theory, the relationship between unit production time and the number of consecutive units of production, was expected to have an

effect on productivity during the experiment, especially in the Individual-unenriched cell. Learning Curve theory is based on three assumptions (Chase & Aquilano, 1977, p. 526):

1. The amount of time required to complete a given task or unit of a product will be less each time the task is undertaken.

2. The unit time will decrease at a decreasing rate.

3. The reduction in time will follow a specific and predictable pattern.

The first assumption applies most directly to this study. As discussed in Chapter 4, the differences in productivity among the cells can be partially explained by this assumption. By repeatedly making the same type of connections, the individual unenriched participants were able to greatly improve their performances during the experiment.

Sensitized subjects. Since the participants were necessarily aware of the experimental nature of the Erector set exercise, the possibility exists that performance of the task and response to the questionnaire were altered by the "Hawthorne Effect" (Kast & Rosenzweig, 1974); that is, the subjects were aware that they were under observation,

and performed in a different manner than they would have under actual working conditions.

Other sensitization of the participants caused by chronological placement of the experiment (the last day of class, for example) or by the biasing comments of the instructors was avoided. The experiment and the subsequent job enrichment seminar were integrated into the course curriculum by the instructors, and any schedule conflicts, such as sessions the day before graduation or Friday afternoons, were completely avoided. The instructors were briefed against biasing the participants, and merely introduced the experimenters as guests speakers from the School of Systems and Logistics.

Methods of Data Analysis

Principal technique. Analysis of Variance (ANOVA) was the principal statistical technique employed to test the hypotheses stated in Chapter 1. ANOVA is a widely used and powerful statistical procedure which is applied to the problem of comparing any number of sample means (Klugh, 1974).

Each observation consisted of the following seven data elements which were analyzed to test the hypotheses:

1. Enrichment (high or low)
2. Task structure (group or individual)
3. Satisfaction with the task
4. Satisfaction with the experimenter
5. Productivity
6. Quality
7. MPS

Two-way ANOVA was accomplished to determine the effects of enrichment and task structure (the independent variables) on the dependent variables of MPS, satisfaction with the task, productivity, and quality.

A posteriori contrast test. A significant F value found on an ANOVA table shows only that the variation among sample means cannot reasonably be attributed to chance (Klugh, 1974). However, through use of a posteriori contrast tests, it can be determined which means are statistically different from others.

The use of Duncan's Multiple Range Test was found to be suitable for this study in conducting a posteriori tests on the sample means, because the comparisons are not made relative to a single critical difference, but are adjusted "depending upon whether the two means being

compared are adjacent, or whether one or more other means fall between those being compared" (Bruning & Kintz, 1977, p. 116).

Summary. This chapter has outlined the methodology used in the conduct of the laboratory experiment. In addition, a description of the sample, enrichment manipulations, and variables is presented. The chapter concludes by explaining the methods of data analysis utilized to study the results of the experiment. Results and analysis of the experimental findings are examined in Chapter 4.

Chapter 4

RESULTS AND ANALYSIS

The laboratory experiment resulted in a variety of insights into the impact of task structure and job enrichment on productivity, quality of work, and job satisfaction. This chapter presents the results of the experiment and analyzes these results in terms of the experimental design used. The first of the three major sections evaluates the effectiveness of the enrichment manipulations by analyzing Motivating Potential Score, its component parts--the job characteristic core dimensions--and the participants' satisfaction with the leader. Second, each hypothesis test and research question is evaluated in light of the experimental results. Finally, an overall summary of the key research findings is presented.

Effectiveness of Enrichment Manipulations

Results--MPS

An analysis of MPS scores of the 122 participants in the experiment indicated that manipulations were highly

effective in producing significant differences in MPS scores between the enriched and unenriched cells. The results of the two-way Analysis of Variance are presented in Table 6. The lack of a significant main effect due to task structure is consistent with the manipulations used to enrich the task. Enrichment efforts are aimed at modification of the job characteristics, and do not specifically address the social situation surrounding the job. Since the Job Diagnostic Survey addresses characteristics of the task performed and not the job social climate per se, the insignificance of the main effect of task structure is predictable. Additionally, a marginally significant two-way interaction indicates that a relationship exists between enrichment and task structure relative to MPS.

A posteriori contrast test. The results of Duncan's Multiple Range Test on MPS means and all core dimensions are shown in Table 5. Duncan's test determined that the only significant differences in mean MPS scores were between the Individual-unenriched cell and all other cells. Insight into this result is found in analysis of the core dimensions later in the chapter.

MPS: a comparison. In comparison with the MPS means for a similar experiment by Horstman and Kotzun (1977),

MPS means from this experiment were much higher for all cells. Both experiments used Erector set tasks and measured MPS by responses to identical surveys. Comparison of the MPS for each cell is presented in Table 4.

Table 4

Mean MPS Scores: A Comparison

Experiment	Individual Unenriched	Group Unenriched	Individual Enriched	Group Enriched
Horstman & Kotzun	26.0	21.3	50.3	35.5
Cameron & Moore	51.4	81.9	105.0	99.4

One possible explanation for the higher MPS scores in this experiment is that the Erector set task used was larger and more complex than the model used in the Horstman and Kotzun study. This increase in complexity allowed for a wider range of experimental manipulations, which in turn increased MPS scores. Scores on every core dimension were higher on this experiment for each of the four cells. The plots of MPS mean scores by enrichment and task structure are shown in Figure 2.

Table 5

Summary of Duncan's Multiple Range Test for the Effects of the Experimental Manipulations of the Job Enrichment Independent Variable

Variable		Means[a]	Homogeneous Subsets
MPS	1	51.437	
	2	81.972	3 > 4 > 2 > 1
	3	105.032	
	4	99.399	
Skill Variety	1	1.672	
	2	2.391	3 > 4 > 2 > 1
	3	3.077	
	4	2.594	
Task Identity	1	4.203	
	2	4.250	3 > 4 > 2 > 1
	3	6.615	
	4	4.675	
Task Significance	1	3.422	
	2	5.047	2 > 4 > 1 > 3
	3	2.862	
	4	4.844	
Autonomy	1	4.203	
	2	4.219	3 > 4 > 2 > 1
	3	5.004	
	4	4.828	
Feedback	1	3.422	
	2	2.500	4 > 3 > 2 > 1
	3	4.819	
	4	4.949	

Any treatment means not underscored by the same line are significantly different. Any treatment means underscored by the same line are not significantly different. Alpha significance value is .05.

[a]Means 1, 2, 3, and 4 refer to Individual Unenriched, Group Unenriched, Individual Enriched, and Group Enriched respectively.

Table 6

Two-Way Analysis of Variance:
Motivating Potential Score

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	21610.55	6.47	.002
Task Structure	1	5479.18	1.64	.200
Enrichment	1	36169.98	10.83	.001
Two-Way Interactions	1	9894.32	2.96	.084
Task Structure x Enrichment	1	9894.32	2.96	.084
Explained	3	17705.14	5.30	.002
Residual	118	3340.42		
Total	121	3696.57		

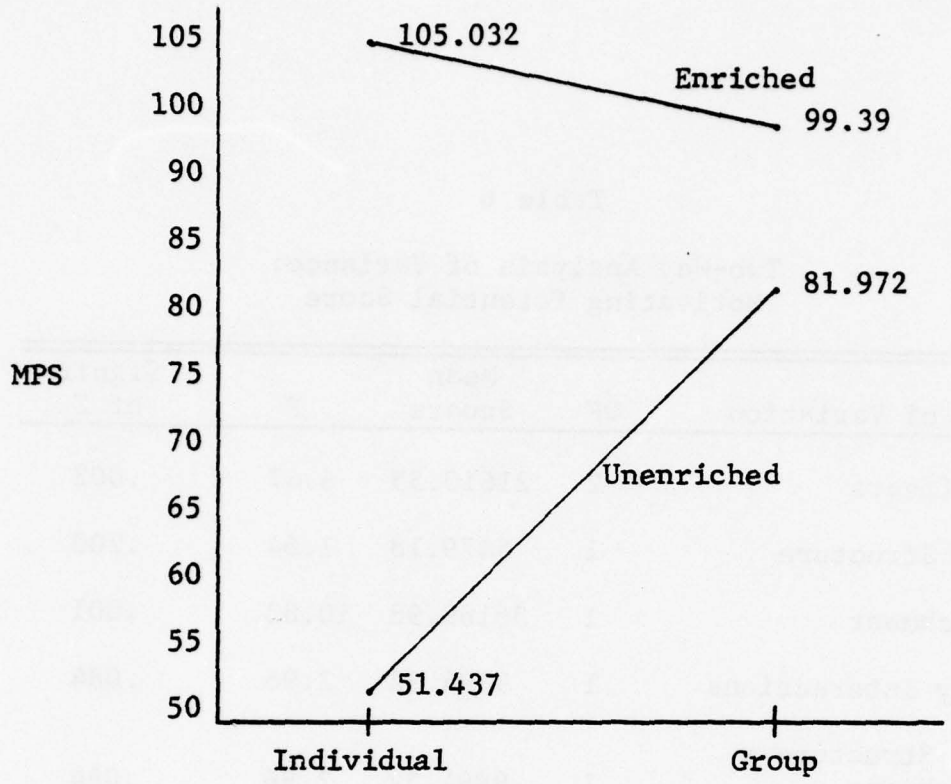


Figure 2

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure Manipulations on MPS

Results--Core Dimensions

All five core dimensions were impacted to some degree by the manipulations. Figures 3 through 7, at the end of this section, plot these means, while Tables 7 through 11 show the results of the two-way ANOVA analyses. With the exception of task significance, the mean scores on core dimensions for the enriched treatment, both group and individual, were higher than those in the unenriched treatment.

Skill variety. One acknowledged problem with the Erector set task is that only a minimal number of different skills are required in construction of even the most complex model. This inherent limitation attenuated the range of any enrichment manipulations. However, there was a significant main effect due to enrichment, but not for task structure, as indicated in Table 7. Duncan's (Table 5) test indicated no significant difference in skill variety between either of the enriched cells. The only other non-significant difference was between the two group skill variety means. This lack of significant difference can be explained by observing that the group enriched model (an arctic radar tower) was a combination of the individual

enriched and group unenriched models. The individual enriched participants constructed a ground-based radar unit model, which was identical to the top portion of the group enriched model. The supporting tower for the radar unit was built by the unenriched group. Since the two partial models were components of the larger model, no significant difference in skill variety would be expected. In addition, groups tended to break down the larger model into smaller parts and "specialized" in construction of a portion of the model. After these components were completed, the group then assembled the complete model. The skill variety mean plots are shown in Figure 3.

Task identity. ANOVA results on task identity are listed in Table 8; plots of the means are presented in Figure 4. Both main effects, enrichment and task structure, were significant on the core dimension of task identity; a two-way interaction effect was also significant. Although both enriched cells built what was obviously a complete model and the experimenters briefed the participants accordingly, the only significant difference in task identity scores was between the Individual-enriched cell and all other cells. These differences could be caused in part by

the nature of the tasks performed. The individual enriched task was obviously a complete model and was assembled by one person. As a result, subjects in the Individual-enriched cell rated the task significantly higher on task identity than did participants in all other cells. The failure of enrichment manipulations in the Enriched-group cell could be a result of the fact that an individual in the group did not perceive completion of the larger model as his "own" work.

Task significance. The results on this core dimension were unexpected. Enrichment manipulations had no effect on task significance scores; however, the main effect of task structure was a significant source of variation among the cells. The group task significance scores were significantly higher than the individual scores. Participants who worked in a group setting seemed to perceive that the task performed was more significant than did the individuals working alone. ANOVA results are reproduced in Table 9, and plots of the task significance means are shown in Figure 5.

Autonomy. Analysis of Variance showed a significant main effect of enrichment on the core dimension autonomy. Although the results in terms of autonomy were in the

expected direction--both enriched cells scored higher than the unenriched cells--Duncan's test showed no significant difference between any of the autonomy means. Table 10 presents the ANOVA results. The plots of means are illustrated in Figure 6.

Instructions given to the participants may have inhibited their perception of autonomy in the enriched cells. Statements such as "make an identical copy of the model you see in front of you," and a prearranged room setting could limit the workers' feelings of autonomy.

Feedback. Both main effects were found to be significant through use of two-way ANOVA (Table 11). The Individual-unenriched cell yielded the lowest feedback score of all the cells (Figure 7). Duncan's test confirmed that the feedback mean for the Individual-unenriched cell was significantly different from the feedback means for all other cells. One major influence in the enriched cells was feedback from the model. Upon completion of the radar unit, the model was operated by the participants; hence, the higher feedback score. The participants in the Unenriched-group cells built more of the total model than participants in the Unenriched-individual cell; as expected,

the feedback score was significantly higher in the unenriched treatment for groups than for individuals.

Satisfaction With the Experimenter

By utilizing the standardized scripts found in Appendices A and B, it was hoped that there would be no significant differences among the experimental cells with regard to the participants' attitudes toward the researchers. A t-test between the mean satisfaction with the experimenter scores for each of the researchers revealed no significant difference between them. However, results of a two-way ANOVA shown in Table 12 indicate a highly significant effect due to the degree of enrichment in the task. Figure 8 shows that the enriched cells were significantly higher in terms of satisfaction with the experimenters. The researchers' behavior was held strictly constant throughout the course of all the experiments, so apparently the degree of enrichment had a profound effect on the participants' overall feelings about anything connected with the exercise. Informal observations of the experimenters did detect a somewhat more dissatisfied atmosphere in the unenriched cells. This result would appear to be expected, since a worker in an unenriched condition would naturally be more unhappy with his overall situation. These findings,

coupled with the discussion of satisfaction with the task later in the chapter, seem to lend more support to job enrichment efforts relative to worker satisfaction.

Table 7

Two-Way Analysis of Variance:
Skill Variety

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	9.58	5.93	.004
Task Structure	1	.69	.43	.999
Enrichment	1	18.05	11.17	.001
Two-Way Interactions	1	10.93	6.76	.010
Task Structure x Enrichment	1	10.93	6.76	.010
Explained	3	10.03	6.20	.001
Residual	118	1.62		
Total	121	1.83		

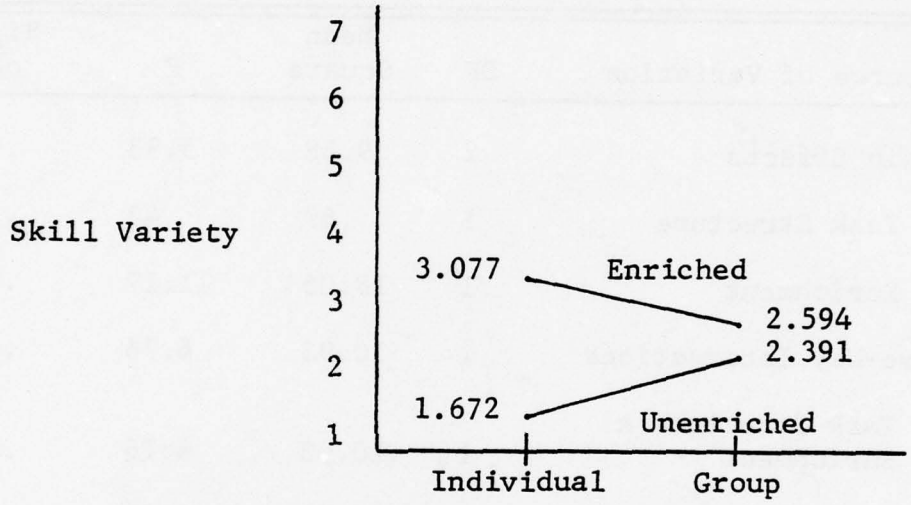


Figure 3

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure on Skill Variety

Table 8

Two-Way Analysis of Variance:
Task Identity

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	38.53	12.57	.001
Task Structure	1	24.17	7.89	.006
Enrichment	1	56.49	18.43	.001
Two-Way Interactions	1	29.87	9.74	.002
Task Structure x Enrichment	1	29.87	9.74	.002
Explained	3	35.64	11.63	.001
Residual	118	3.07		
Total	121	3.87		

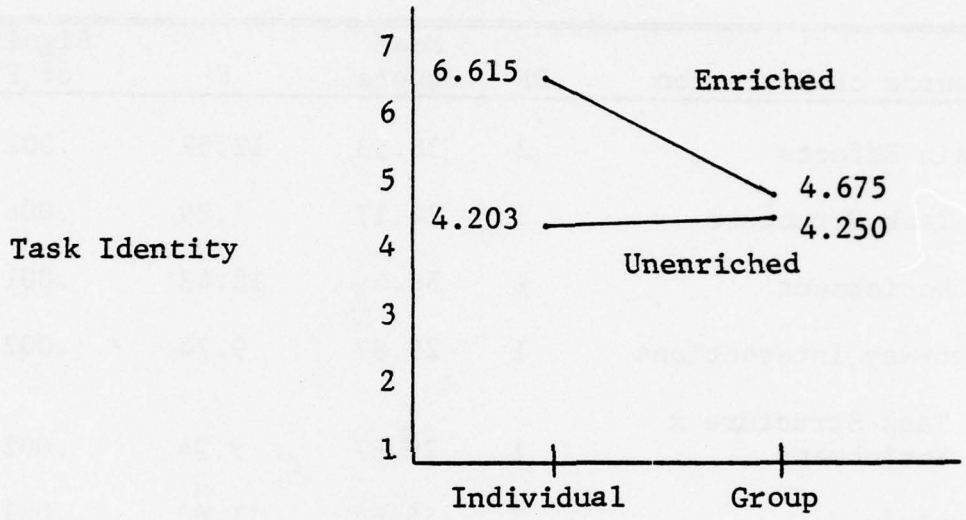


Figure 4

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure on Task Identity

Table 9

Two-Way Analysis of Variance:
Task Significance

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	50.01	20.51	.001
Task Structure	1	97.65	40.05	.001
Enrichment	1	4.19	1.72	.189
Two-Way Interactions	1	.97	.39	.999
Task Structure x Enrichment	1	.97	.39	.999
Explained	3	33.66	13.81	.001
Residual	118	2.44		
Total	121	3.21		

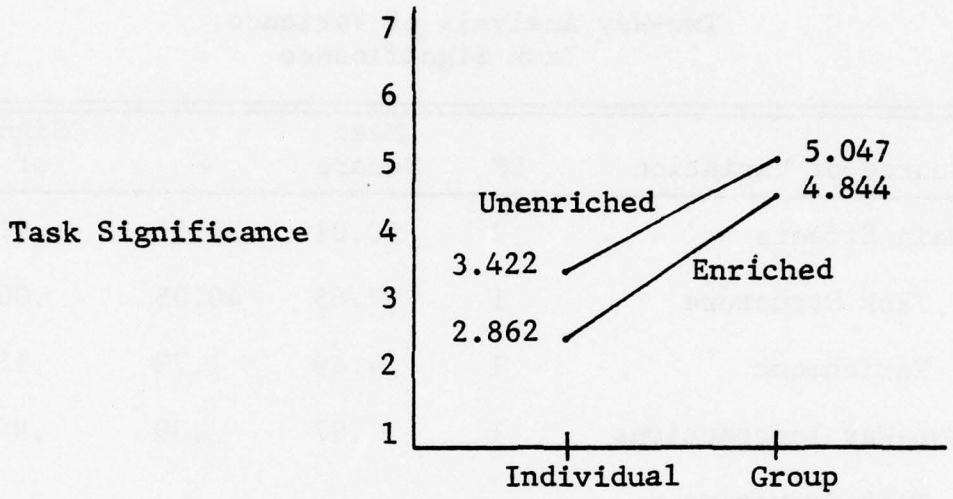


Figure 5

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure on Task Significance

Table 10

Two-Way Analysis of Variance:
Autonomy

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	7.45	2.42	.092
Task Structure	1	.17	.06	.999
Enrichment	1	14.86	4.82	.029
Two-Way Instructions	1	.28	.09	.999
Task Structure x Enrichment	1	.28	.09	.999
Explained	3	5.06	1.64	.182
Residual	118	3.09		
Total	121	3.13		

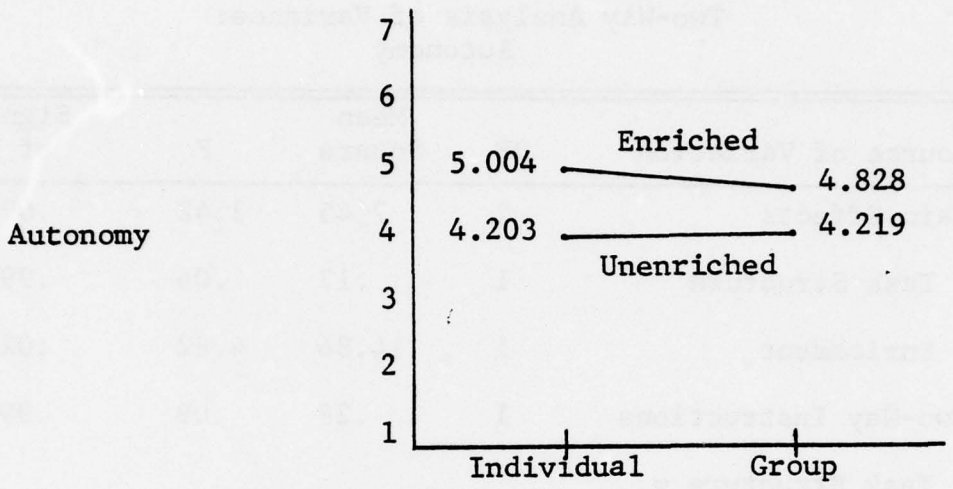


Figure 6

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure on Autonomy

Table 11

Two-Way Analysis of Variance:
Feedback

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	19.66	8.10	.001
Task Structure	1	12.39	5.11	.024
Enrichment	1	25.00	10.30	.002
Two-Way Interactions	1	6.52	2.69	.100
Task Structure x Enrichment	1	6.52	2.69	.100
Explained	3	15.28	6.29	.001
Residual	118	2.43		
Total	121	2.75		

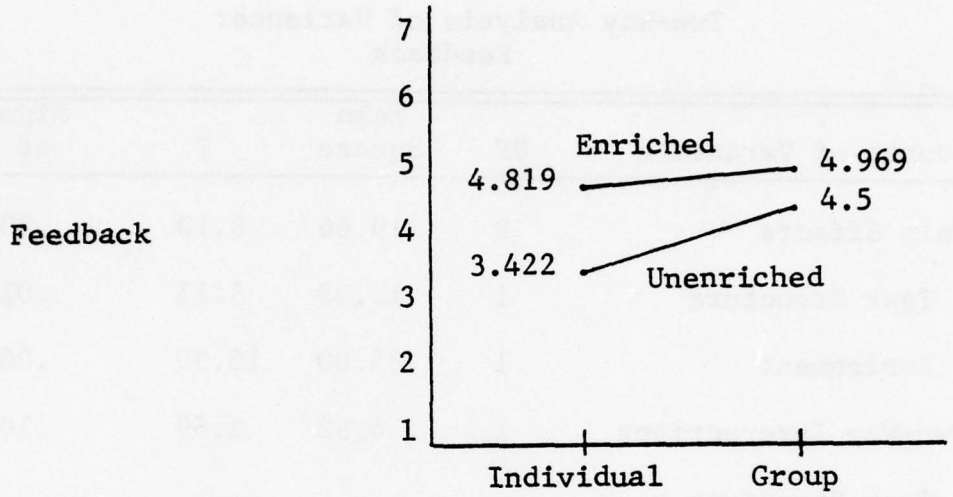


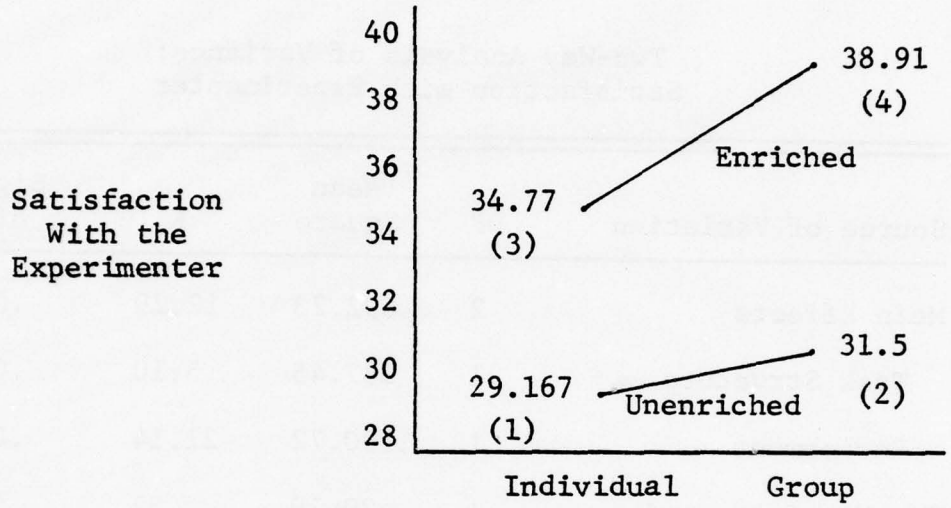
Figure 7

Three-Factor Diagram Showing Impact of Enrichment and Task Structure on Feedback

Table 12

Two-Way Analysis of Variance:
Satisfaction with Experimenter

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	692.23	12.29	.001
Task Structure	1	287.45	5.10	.025
Enrichment	1	1190.72	21.14	.001
Two-Way Interactions	1	20.79	.37	.999
Task Structure x Enrichment	1	20.79	.37	.999
Explained	3	468.41	8.32	.001
Residual	104	56.33		
Total	107	67.88		



$4 > 3 > \underline{2 > 1}$

Figure 8

Three-Factor Diagram Showing Impact of Enrichment and Task Structure on Satisfaction with the Experimenter and the Results of Duncan's Multiple Range Test

Hypothesis Tests

This section first discusses the overall impact of enrichment and task structure on satisfaction, productivity, and quality, and then discusses specific hypotheses and research questions. The applicable tables and figures follow each section as appropriate.

Overall Impact on Satisfaction

The results of the two-way ANOVA on satisfaction data are shown in Table 14. The main effect of enrichment was shown to impact significantly on the participants' satisfaction with the Erector set task, while the other main effect, task structure, was not significant. However, the results also showed that interactive effects were significant, indicating that a definite relationship exists between enrichment and task structure in producing increased satisfaction with the task. Plots of the means shown in Figure 9 and the results of Duncan's Multiple Range Test shown in Table 13 indicate that the enriched cells were both significantly higher than the unenriched cells, supporting the overall thrust of the study stated in Chapter 1. The lowest mean satisfaction score by far

was the Unenriched-individual cell. Duncan's test found no significant difference between the two enriched cells, so apparently it made no difference if the participants worked in groups or as individuals. This could indicate that they had a more interesting task in the Enriched-Individual cell and possibly perceived more autonomy and task identity, leading to greater satisfaction (Hackman & Suttle, 1977). In the unenriched task, the group structure was successful in producing greater satisfaction. The Unenriched-group cell was significantly higher than the Unenriched-individual cell.

Hypotheses--Satisfaction

Hypotheses 3.a. through 3.e. address the impact of enrichment and task structure on satisfaction with the task, and are restated below.

3.a. Groups working on enriched tasks will have a higher level of satisfaction than groups working on unenriched tasks.

3.b. Individuals working on enriched tasks will have a higher level of satisfaction than individuals working on unenriched tasks.

3.c. Groups working on unenriched tasks will have a higher level of satisfaction than individuals working on unenriched tasks.

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3.d. Groups working on enriched tasks will have a higher level of satisfaction than individuals working on unenriched tasks.

3.e. Individuals working on enriched tasks will have a higher level of satisfaction than groups working on unenriched tasks.

As can be seen from Figure 9, all five hypotheses were supported by the experiment. Duncan's test demonstrates that both the enriched cell means were significantly higher than the unenriched cell means. The a posteriori analysis also indicated a significant increase in satisfaction when the unenriched task was accomplished in a group arrangement. This result supports the contention that dull, uninteresting jobs are more satisfying when performed in groups (Horstman & Kotzun, 1977).

Research Question--Satisfaction

The following research question on satisfaction was addressed by this study:

> Will groups working on enriched tasks have a higher level of job satisfaction than individuals working on enriched tasks?

This question revealed some interesting results. Although Figure 9 shows that the enriched individual mean was higher, the result of Duncan's test indicates that the

two means are not significantly different. This seems to indicate that either structure, when coupled with an enriched condition, will work to create higher job satisfaction.

Table 13

Summary of Duncan's Multiple Range Test for the Effects of the Experimental Manipulations

Variable	Means[a]		Homogeneous Subsets
Satisfaction With Task	1	16.25	3 > 4 > 2 > 1
	2	23.563	
	3	31.654	
	4	30.0	
Productivity	1	1.528	1 > 3 > 2 > 4
	2	.854	
	3	1.085	
	4	.643	
Quality	1	.907	4 > 3 > 1 > 2
	2	.848	
	3	.908	
	4	.914	

Any means not underscored by the same line are significantly different. Any means underscored by the same line are not significantly different. Alpha significance value is .05.

[a]Means 1, 2, 3, and 4 refer to Individual Unenriched, Group Unenriched, Individual Enriched, and Group Enriched respectively.

Table 14

Two-Way Analysis of Variance:
Satisfaction with the Task

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	1929.38	13.43	.001
Task Structure	1	286.72	1.99	.157
Enrichment	1	3458.70	24.07	.001
Two-Way Interactions	1	608.08	4.23	.040
Task Structure x Enrichment	1	608.08	4.23	.040
Explained	3	1488.95	10.36	.001
Residual	118	143.69		
Total	121	177.05		

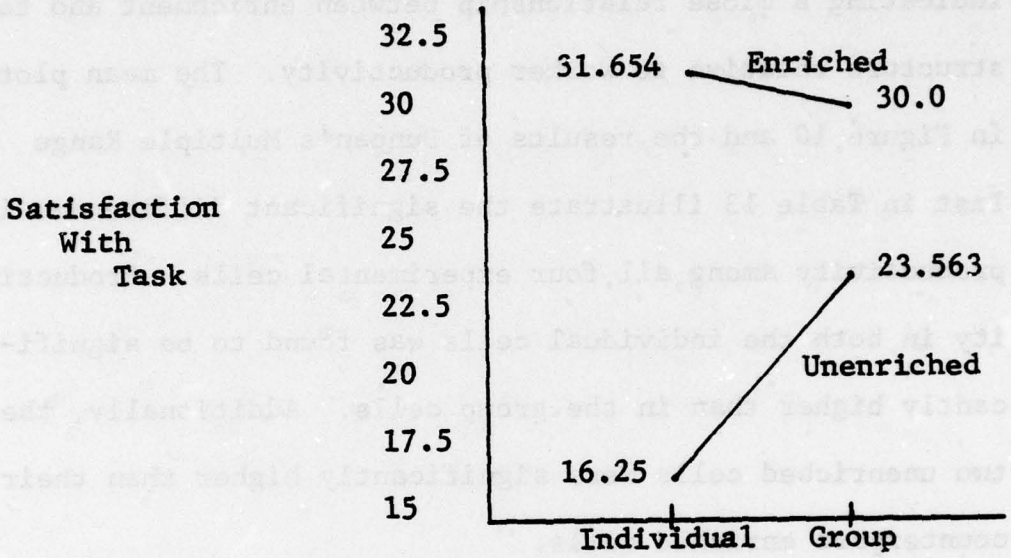

Figure 9

Three-Factor Diagram Showing Impact of Enrichment and Task Structure on Satisfaction With Task

Overall Impact on Productivity

The ANOVA analysis of productivity data in Table 15 shows that both main effects were highly significant, and that there was also a strong interactive effect, indicating a close relationship between enrichment and task structure relative to worker productivity. The mean plots in Figure 10 and the results of Duncan's Multiple Range Test in Table 13 illustrate the significant differences in productivity among all four experimental cells. Productivity in both the individual cells was found to be significantly higher than in the group cells. Additionally, the two unenriched cells were significantly higher than their counterpart enriched cells.

One possible explanation for the individuals' higher level of productivity was alluded to in Chapter 3. The Learning Curve theory appeared to affect individual performance substantially, especially in the Unenriched-individual cell, where productivity was significantly higher than in the other three cells. The experimenters themselves observed this phenomenon in action while preparing for the laboratory sessions. The increased task variety in the group tasks tended to decrease the possibility

of any Learning Curve effect. In contrast, the unenriched individual participants merely repeated identical connections throughout the allotted time period.

Another possible explanation is the idea of "group process loss" discussed by Steiner (1972). The extra time required for discussion and establishment of production strategies in the groups would naturally slow them down and reduce productivity.

Hypotheses--Productivity

Hypotheses 2.a. through 2.e. are concerned with the impact of enrichment and task structure on productivity. Hypotheses 2.a. and 2.b., as repeated below, are concerned with the question of enriched tasks vs. unenriched tasks.

2.a. Groups working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

2.b. Individuals working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

Neither hypothesis was supported by the research findings. In both cases, productivity was significantly lower in the enriched cells rather than higher.

Hypotheses 2.c. and 2.d., stated below, are concerned with group vs. individual task structure.

2.c. Groups working on unenriched tasks will have greater productivity than individuals working on unenriched tasks.

2.d. Groups working on enriched tasks will have greater productivity than individuals working on unenriched tasks.

Both of these hypotheses were rejected by the results. The mean plots and the results of Duncan's test show that the individual cell participants produced at significantly higher levels than the group cell participants.

Only hypothesis 2.e. was supported by the research.

2.e. Individuals working on enriched tasks will have greater productivity than groups working on unenriched tasks.

Here, the individual nature of the task, combined with a high degree of enrichment, resulted in significantly superior levels of production when compared with an unenriched group task.

Research Question--Productivity

This study addressed the following research question concerning productivity:

Will groups working on enriched tasks have greater productivity than individuals working on enriched tasks?

In this study, the enriched individuals produced at significantly higher levels of output than did groups working on enriched tasks. This result indicates that decreases in productivity due to the "group process loss" described by Steiner (1972) were apparently very much in evidence during the experiment. While the enriched cells did not have as high a level of productivity as the un-enriched cells, the results appear to show that individuals are superior to groups in terms of productivity.

Table 15

Two-Way Analysis of Variance: Productivity

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	6.69	109.33	.001
Task Structure	1	9.66	157.78	.001
Enrichment	1	3.12	51.01	.001
Two-Way Interactions	1	.41	6.67	.011
Task Structure x Enrichment	1	.41	6.67	.011
Explained	3	4.60	75.12	.001
Residual	118	.06		
Total	121	.17		

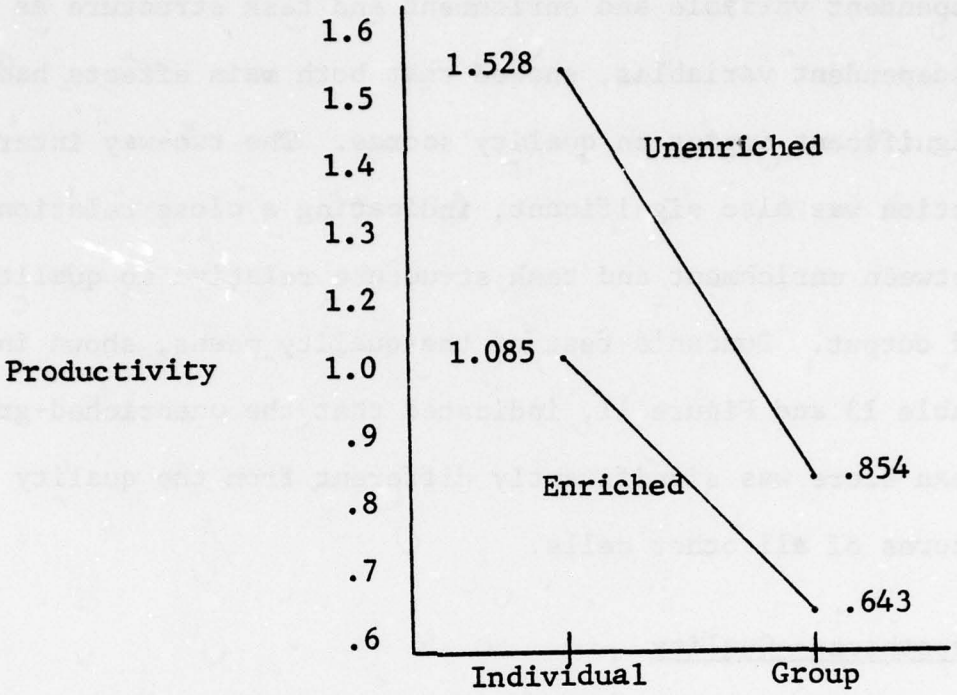

Figure 10

Three-Factor Diagram Showing Impact of
Enrichment and Task Structure on Productivity

Overall Impact on Quality

Analysis of Variance (Table 16) using quality as the dependent variable and enrichment and task structure as the independent variables, showed that both main effects had a significant impact on quality scores. The two-way interaction was also significant, indicating a close relationship between enrichment and task structure relative to quality of output. Duncan's test of the quality means, shown in Table 13 and Figure 11, indicated that the unenriched-group mean score was significantly different from the quality scores of all other cells.

Hypotheses--Quality

Hypotheses 1.a. through 1.c. address the impact of enrichment and task structure on quality of workmanship and are restated below.

1.a. Groups working on enriched tasks will produce higher quality output than groups working on unenriched tasks.

1.b. Individuals working on enriched tasks will produce higher quality output than individuals working on unenriched tasks.

1.c. Groups working on unenriched tasks will produce higher quality output than individuals working on unenriched tasks.

1.d. Groups working on enriched tasks will produce higher quality output than individuals working on unenriched tasks.

1.e. Individuals working on enriched tasks will produce higher quality output than groups working on unenriched tasks.

Hypothesis 1.a. was supported by experimental results. Duncan's test showed that in comparison to all other cells, quality was significantly lower in the Unenriched-group cell.

There was no support in the experiment for hypotheses 1.b. through 1.d. Duncan's test yielded no significant difference among either enriched cell and the Unenriched-individual cell on mean quality scores. The relative ease of completing a "good" model possibly prevented a wide range of quality scores and somewhat inhibited analysis of this variable.

The final hypothesis, 1.e., was supported by this experiment. Enriched-individual cell mean quality scores were significantly different from those in the Unenriched-group cell. Again, this difference in quality could be a function of the task and not the experimental treatments.

Research Question--Quality

The following research question addressed the findings on quality:

> Will groups working on enriched tasks produce higher quality output than individuals working on enriched tasks?

Although in this study the enriched group quality mean was slightly higher than the enriched individual quality mean, no significant difference was uncovered by Duncan's test results. Therefore, the results indicate that neither of the experimental treatments, enrichment and task structure, resulted in any change in quality, a result that is consistent with previous research efforts.

Table 16

Two-Way Analysis of Variance: Quality

Source of Variation	DF	Mean Square	F	Signif of F
Main Effects	2	.030	5.12	.007
Task Structure	1	.025	4.27	.039
Enrichment	1	.038	6.49	.012
Two-Way Interactions	1	.032	5.54	.019
Task Structure x Enrichment	1	.032	5.54	.019
Explained	3	.031	5.26	.002
Residual	118	.006		
Total	121	.006		

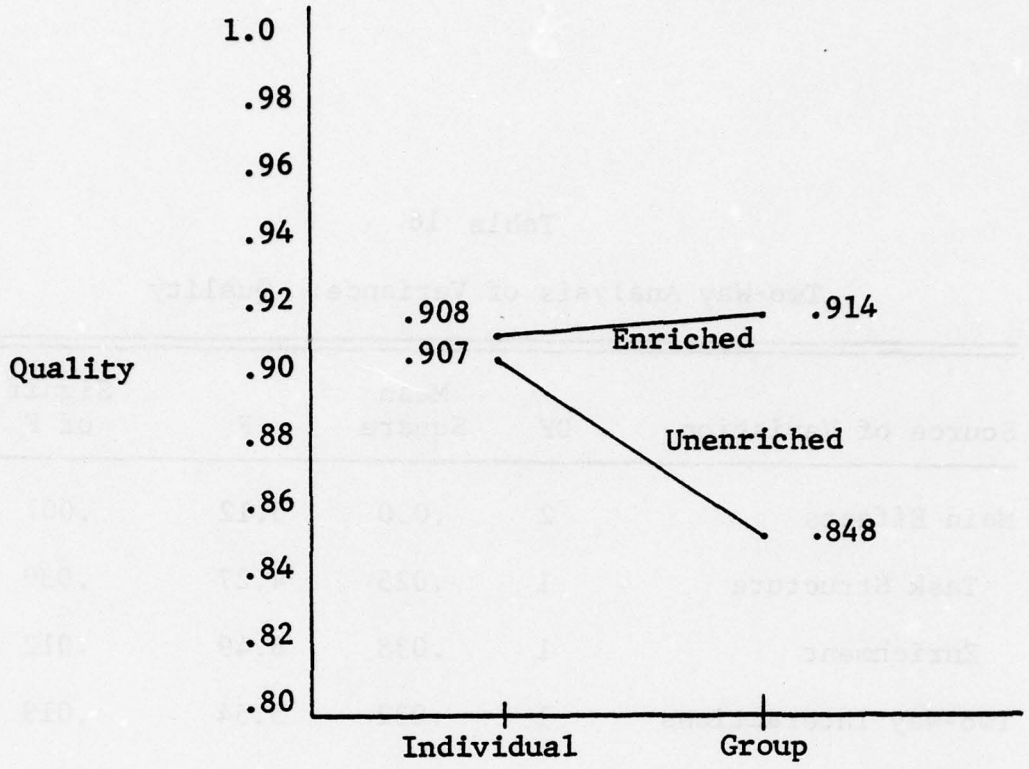

Figure 11

Three-Factor Diagram Showing Impact
of Enrichment and Task Structure on Quality

Summary of Results

Manipulations. The analysis of both MPS and the job characteristics core dimensions revealed the effectiveness of the experimental manipulations. With the exception of the core dimension task significance, enrichment manipulations were effective in producing higher core dimension mean scores in the enriched cells. The total impact of these higher scores for the enriched group was sufficient to produce significantly different MPS scores between enriched and unenriched experimental cells.

Impact of job enrichment. Strong support was found for the contention that job enrichment increases worker satisfaction. The relationship between job enrichment and work quality was much less pronounced. In terms of quality, the output of individuals working on the unenriched task was not significantly different from the enriched cells output. In the unenriched group, however, participants produced consistently lower quality work than participants in all other cells.

Job enrichment and group task structure both had a significant negative impact on worker productivity in this study. This lessoning of productive output may have been the result of the complexity of the model in the enriched

conditions and of group process loss in the group cells rather than enrichment manipulations.

Chapter 5 analyzes these results in light of current theory and proposes some implications for management concerning use of job enrichment and group or individual task structure.

Chapter 5

CONCLUSIONS AND IMPLICATIONS

Using the review of the literature and the results of the experiment as a point of reference, this chapter views the research effort from a broad perspective. The discussion focuses on the conclusions and implications concerning the effects of job enrichment and task structure on productivity, satisfaction, and quality of work, and finishes with a short discussion of the internal and external validity of the experiment.

Conclusions: Satisfaction

The results show the strong positive effect of enrichment on satisfaction with the task being performed. The participants who worked in groups doing an unenriched job displayed a significantly higher level of satisfaction than those who worked individually in an unenriched job. Similar findings were reported by Horstman and Kotzun (1977). Apparently, people working in groups compensate for many of the undesirable aspects of an unenriched job.

Enrichment efforts also had a dramatic effect on individual tasks. The largest difference in satisfaction was between the participants working individually on an unenriched task and those working individually on an enriched task. This finding supports the contention that while enrichment can succeed for group tasks, it has the most potential for increasing satisfaction in individually designed jobs.

The overall findings concerning satisfaction point out several important implications for Air Force managers. Porter and Steers (1973) found that overall job satisfaction represents an important force in the worker's retention and absenteeism rates. Recent articles concerning pilot retention, training costs, and readiness (AF Times, 1978) have highlighted the importance of morale and satisfaction to the Air Force worker. Programs in the Air Force Logistics Command and at Ellsworth Air Force Base with the security police have already shown the efficacy of such enrichment efforts (Gates, 1977). It is apparent, with today's all-volunteer force, that problems with retention of personnel and the attendant high turnover and training costs are of paramount importance. The results of this research indicate that many of these retention problems

could be alleviated by careful applications of enrichment and job design programs. The implications are that higher levels of satisfaction can be achieved in unenriched jobs by using group task structures, and, in jobs requiring individual effort, job enrichment programs can do much to increase satisfaction.

Conclusions: Productivity

The overall findings of this study revealed that productivity appears to be affected the most by task structure; in all cases, individuals working alone produced more per person than those working in groups. In addition, the unenriched participants produced more than the enriched participants.

From a casual observation of these results, it would appear that the most effective method of accomplishing a simple, routine task would be to have individuals accomplish the task in an unenriched environment. This conclusion is not surprising; it is a basic concept of scientific management.

Other research efforts, however, have failed to show this inverse relationship between level of enrichment and productivity. Most studies report either increased

productivity or no change in productivity due to job enrichment (Umstot, 1975; Hackman & Lawler, 1971).

As discussed previously, the effect of Learning Curve theory may have given the unenriched individual participants a slight advantage in production. In addition, group production was inhibited by group process loss--time spent in organization and coordination of the group's effort was time lost to productive output. Also, when making the enriched vs. unenriched productivity comparison, one must consider the negative impact on productivity due to the increased complexity of the models constructed by the enriched participants.

Given this information, what are the implications for management? First, job enrichment is not the approach to use when the goal is to increase productivity. This experiment showed significantly lower productivity, in terms of units produced per unit of time, for people working on enriched jobs. Other researchers have shown job enrichment to have little, if any, effect on productivity. Second, if a job is designed for a group, the manager can reasonably expect an initial decrease in productivity as a result of group process loss. As group coordination and organization improve, the effects of group processes may be diminished.

Third, on simple tasks, one might expect higher productivity from individuals working alone; however, as the task becomes more complex and worker interdependence becomes a factor, the individual's advantage may diminish substantially. Finally, if enrichment of a specific job results in a significant increase in overall task complexity, management should expect at least a temporary decrease in productivity.

Conclusions: Quality

Little evidence was found in this study to support the contention that job enrichment efforts lead to increased quality. This result is consistent with many researchers' findings, but Lawler (1969) reported ten studies that demonstrated work quality improvements as a result of job enrichment. The only notable difference in quality in this experiment occurred in the unenriched group condition--their quality was significantly lower than any other condition. This result may indicate that the use of groups on an unenriched job may have a detrimental effect on quality, possibly due to the group members' negative reinforcement of low quality norms during job performance. The implication is that, in the absence of close supervision, management should probably avoid a group task structure when high quality is desired and the task is simple and routine.

Summary of Findings

The overall findings of this study showed that both task structure and job enrichment had a direct impact on satisfaction. As expected, participants in the enriched conditions displayed significantly higher levels of satisfaction with the task. This study supported the use of group task structure as a means for increasing worker satisfaction in unenriched jobs. In contrast, the worst job, in terms of satisfaction, was the unenriched individual. Thus, it appears that well-designed, properly applied job enrichment programs can go a long way toward alleviating morale and motivation problems among dissatisfied workers.

Although task structure and enrichment affected productivity, the results were in an unexpected direction. Both job enrichment and group task structure resulted in significantly lower productivity. However, other factors such as group process losses, Learning Curve effects, and task complexity may have accounted for these differences. It appears that a reasonable conclusion is that for simple tasks, a group approach results in decreased productivity.

Enrichment had no effects on quality. However, groups working in the unenriched condition produced significantly lower quality work. Therefore, there was no

evidence to support the efficacy of job enrichment programs for improving quality. Thus, while group task structure may succeed in increasing overall work satisfaction, these increases may be offset by decreases in quality.

Given these findings, what are the implications for management? First, if overall worker satisfaction is of primary importance, managers should design enriched jobs for individuals. If job enrichment is not possible, a group structure can result in higher satisfaction. Second, when the manager's sole concern is increased productivity, jobs should be simplified as much as possible and designed for individuals. Finally, group task structure should be used on boring, unenriched jobs only where high quality is a minor concern or where close supervision is possible.

Validity of the Experiment

Internal validity. Internal validity is considered to be successfully achieved when the influencing extraneous variables have either been eliminated or handled such that the pertinent variables have, in fact, been measured and have contributed to the results (Clover & Balsley, 1974). Laboratory experimentation is advantageous for increasing internal validity because close control over the experimental

setting is possible. Due to the standardized instructions, the random assignment of participants to experimental conditions, and the short duration of the experiment, threats to internal validity were controlled. Thus, the sample data collected are considered to be valid with little threat to internal validity.

External validity. External validity is largely a matter of generalizability or process of extrapolation of findings beyond the data collected (Emory, 1976). One key concern involves finding areas of commonality between the sample and the population to which results are inferred (Horstman & Kotzun, 1977).

Participants in this experiment came from a wide range of specialty fields and grade levels, both civilian and military, and most could be considered as career-oriented, middle level managers. This inherent diversity, coupled with the random assignment of the individuals to experimental treatments, yielded a sample that is probably typical of middle management in many DOD career fields. However, the Air Force's job enrichment efforts are generally focused on the blue-collar portion of the work force. As a result, the degree of similarity between the

values and attitudes of middle level managers and blue-collar workers comes into question, and may limit the generalizability of the sample.

Another threat to external validity concerns the ability of a short experimental task to capture the essence of a real world application of job enrichment. This is a difficult question to answer. Admittedly, the task is a greatly simplified version of any labor-intensive job. This simplification is one of the tradeoffs that must be considered when making the decision to use a laboratory experiment. In this study, even with a highly simplified task, enrichment manipulations were successful in achieving significant differences in the participants' perceptions of differing job characteristics. The experiment successfully created an enriched task that had a Motivating Potential Score very similar to on-going jobs in real organizations. Thus, it can be concluded that, in spite of its simplicity, the task is fairly representative of real-world work situations.

While ability to generalize results to a population outside the DOD is somewhat limited, the controls allowed by using a laboratory experiment, coupled with reasonable

external validity, allow the findings to be extrapolated to the general DOD work force. Generalizations must be done with caution, but there appear to be few serious threats to internal or external validity that would cause concern.

APPENDIX A

Script 1: Enriched Task--Group & Individual

I. Introduction to Participants

A. Setting: All participants assembled in regular classroom.

B. Thesis advisor introduces experimenters as follows:

"Good morning (afternoon). I'm Lieutenant Colonel Umstot from the faculty of the AFIT Graduate School of Logistics and we are here to conduct a short experiential learning exercise. This exercise will augment a research project, so it has several purposes.

"To conduct this exercise, we will be breaking up into smaller groups and moving to separate classrooms. To make this easier, we will now assign everyone a number. Please remember this number until you get to the next classroom.

"The following people are assigned Number 1." (Advisor reads names, which constitute the unenriched individual cell participants.)

"The following people are assigned Number 2." (Advisor reads names, which constitute the first group of the unenriched group cell.)

"The following people are assigned Number 3." (Advisor reads names, which constitute the second group of the unenriched group cell.)

"Will these individuals, with numbers 1 through 3, please follow (name of experimenter) to another room."

C. At this point, approximately half the class leaves with the experimenter for the unenriched cells. Script 2 for this segment is found in Appendix B. The advisor continues:

"The following people are assigned Number 4." (Advisor reads names, which constitute the enriched individual cell participants.)

"The following people are assigned Number 5." (Advisor reads names, which constitute the first group of the enriched group cell.)

"The following people are assigned Number 6." (Advisor reads names, which constitute the second group of the enriched group cell.)

"Will these individuals please follow (name of experimenter) to another room."

II. Subsequent Conduct of the Laboratory Experiment

A. Setting: All participants in the enriched cells (whether group or individual approach) will be led to the classroom where the enriched individual participants will work. Initially, all participants will be briefed jointly.

B. Set-up of "Enriched Individual" room:

1. Each participant will have a chair and work table. Extra chairs will be positioned in the room to permit enriched group participants to sit during the joint briefing.

2. The following items will have been pre-positioned on each work table:

a. Enough parts in a pie-tin in the middle of the table to build one model.

b. One screwdriver and one wrench.

C. Initial instructions: Upon entering the room with participants, experimenter gives the following instructions:

"Will all the individuals assigned Number 4 please take a seat at one of the work tables. Other individuals will be leaving this room shortly. Please be seated in the chairs remaining, or continue standing."

(after places are found) "In this exercise, we will be studying how well people perform on various types of tasks. Please observe the work tables. On these tables, you will see an assortment of Erector set parts, a screwdriver, and a wrench.

"We would like you to construct one identical copy of the radar set. Time is limited, so please work as quickly as possible. You have approximately 30 minutes to complete the task.

"An already assembled model has been positioned on the table between the work tables.

"This task will enable you, as managers, to learn more about designing jobs for the people that work for you. Even though the task may seem rather simple, it has important real world implications.

"In addition, we hope your participation here will further understanding of DOD motivational issues.

"What you are building here is a complete model. Since you are producing it from start to finish, only you are responsible for the quality and quantity of your work. When you are finished, you will test your model to see if it works using the batteries provided. If it doesn't, you trouble shoot and fix it.

"Feel free to move around the classroom if you desire. I will be happy to answer questions, but please do not talk to your classmates during this exercise.

"When you have finished, leave your completed radar set model on the table in front of you. Do not disassemble any models--you will not be asked to disassemble them after the exercise.

"After you have finished, please raise your hand. I will then ask you to fill out a short questionnaire concerning the exercise you have just completed. Please be as honest and as accurate as you can in answering the questionnaire.

"Are there any questions? If not, the Number 4's may begin work." (Experimenter note the time). "Will Numbers 5 and 6 please follow me to another room?

D. Set-up of "Enriched Group" room:

1. Each team will have one work table and four chairs. The table will be labeled with group numbers to facilitate seating.

2. A completed example of the Erector set model will be positioned on each work table.

3. Enough parts will be placed in pie-tins on each table to permit construction of one model.

4. A screwdriver and a wrench will be placed at each work position.

E. Instructions to Enriched Groups: experimenter continues instructions as enriched group cell participants enter room:

"Please be seated at the table which bears your group number."

(after participants are seated) "You will be building a complete Erector set model, indlucing the radar set with an arctic tower added. Each team will be responsible for putting the model together from start to finish and testing it when it is completed. A sample of the model is in the center of your work table.

"Your team is free to devise its own work strategy and assembly process. You are free to move about and talk to your other team members.

"Time is limited, so work as quickly as possible. You have approximately 30 minutes to complete the tower.

"Are there any questions? If not, please begin work."

III. Administration of the Post-exercise Questionnaire

A. Enriched Individual participants:

1. As each individual completes work, note the time, and present him with a questionnaire to complete.

2. Insure that each individual leaves his completed questionnaire at his work table.

3. When all individuals have completed the questionnaire, tell them to take a short break and then return to their original classroom by (time).

B. Enriched Group participants:

1. As each group completes work, note the time, pass out the questionnaire, and caution them not to talk to each other while filling them out.

2. Insure that each individual leaves his questionnaire at his work table.

3. When all individuals have completed the questionnaire, tell them to take a short break and then return to their original classroom by (time).

APPENDIX B

Script 2: Unenriched Task--

Group & Individual

Note: This script outlines conduct of the experiment for the unenriched cells after the introduction by the advisor has been made, participants have been assigned numbers, and the leader guides participants to the appropriate classroom. This introductory sequence may be found in Appendix A.

I. CONDUCT OF THE LABORATORY EXPERIMENT AFTER INTRODUCTION

A. Setting: Participants in the unenriched cells will be immediately divided into two rooms--one for individual performance, one for group performance. The following instructions will be given as all participants enter the room designated for individual performance:

"Will all individuals with Number 1 please take a seat at one of the work tables."

"Will individuals with Numbers 2 and 3 please step into the next room (points if necessary) and take a seat at the table with your number on it. I'll be right back."

B. Set-up of "Unenriched Individual" room: Experimenter returns to individual room where materials, tables have been prepositioned as follows:

1. Each participant will have a chair and work table.

2. The following items will have been prepositioned on each work table:

a. Already constructed sample Erector component to be built.

b. Erector parts in containers in sufficient quantities to make four components.

c. One screwdriver and one wrench.

3. The participants will build one of the three following components:

   a. Base of the radar tower (3x4)

   b. Top of the radar tower (2x3)

   c. Supports and legs of the radar tower.

4. Work tables will be arranged so as to prevent participants from observing classmates.

C. Instructions to "Unenriched Individual" cell participants: After directing the group participants to be seated in a separate room, the experimenter returns to the first classroom where participants working alone are seated at work tables. The following instructions are given:

"Please observe the work tables in front of you. On those tables you will see a selection of Erector set parts, an Erector set component made from those parts, and some tools.

"We would like you to use these parts to put together exact copies of the assembled unit you see on the table. We would like you to build as many of these units as you can until we tell you to stop. You will be given 30 minutes.

"The task before you is not an especially difficult one. In fact, we expect that individuals of your grade-level will find it very easy. Even so we are interested in finding out how many of the units you can produce.

"What you are building here are actually only components of larger Erector models. We plan to have someone else finish the model at a later time. Hence, you are not going to be held responsible for the larger model when it is finished, but only for the work you do now. Someone else will later check the quality of the whole model.

"You should have enough parts in front of you to continue working until time is called. However, if you run out of parts, tell me and I will get you more. Please do not leave your seat at any time and please do not talk to your classmates during this exercise.

"Are there any questions? If not, please begin work."

D. Set-up of "Unenriched Group:"room: After reciting the foregoing instructions, the experimenter returns to the room where unenriched groups are waiting. The rooms will have been setpup as follows:

1. Each group will have one work table and four chairs. The table will have been labeled with a team number (2 or 3) to facilitate seating.

2. Each position at the work table will be labeled with a number from one to four. This will be done to identify the assembly line process used to construct a component.

3. A single subassembly will be built in assembly line fashion, with each member building a portion of the subassembly. Each group member will be assigned to build one of the following components:

   a. Half of the base plate (2 individuals will be assigned this task)

   b. Vertical corner legs

   c. Diagonal leg braces and horizontal braces

4. Parts sufficient to build 3 subassemblies will be separately placed at each work position, according to the task performed at that position.

5. A screwdriver and a wrench will be at each position.

E. Instructions to "Unenriched Group" cell participants: After entering the room, the experimenter will give the following instructions:

"Please observe the materials on your team work tables. You should see a variety of Erector set parts, a sample of a subassembly which will be made from these parts, and some tools.

"We would like you to work as a group to put together as many exact copies of the Erector component as you can, until time is called. You will be given 30 minutes. Your group is not allowed to start another component until one is completed.

"As you can notice, we would like you to operate in assembly line fashion. Each team member will complete only part of the subassembly.

"Team members at positions 1 and 2 will build the base. Each worker will complete a 2x3 section. When both sections are completed, they will be connected to form the base plate.

"Team member number 3 will build the vertical supports.

"Team member number 4 will build the diagonal and horizontal braces.

"When all group members have completed their individual tasks you will work together to build the component you see here. Build as many subassemblies as possible within the 30 minute time period.

"The task before you is not an especially difficult one. In fact, we expect that individuals of your grade-level will find it very easy. Even so, we are interested in finding out how many of the units you can produce.

"I want to emphasize that what you are building here are actually only components of larger Erector models. We plan to have someone else finish the model at another time. Hence, you are not going to be held responsible for the large model when it is finished, but only for the work you do now. Someone else will later check the quality of the whole model.

"Leave completed units on the table as indicated. There should be enough parts in front of you to continue working until time is called. Please raise your hand if you run out.

"Please do not get up from the table during this exercise, or talk to members of the other team.

"Are there any questions? If not, please begin work."

II. ADMINISTRATION OF THE POST-EXERCISE QUESTIONNAIRE

A. After 30 minutes of work, the experimenter will call time and administer the questionnaire. Approximately 3 minutes will separate start times of the two groups (individual and group). Thus, time will be stopped first in the individual cell and the questionnaire administered, then in the group cell and the questionnaire administered. Directions provided will be identical in both groups and are as follows:

"Please stop work. Leave all parts and tools in front of you.

"At this time, we would like you to complete a short questionnaire on the Erector set task you have just completed. Please be as honest as you can in answering this questionnaire.

"Please do not talk to anyone else while filling it out. After you have completed the questionnaire, please leave it at your work position. You may then take a short break and return to your regular classroom by (time)."

B. Experimenter then passes out questionnaire and insures that participants leave it at their work positions to enable match of work accomplished to appropriate questionnaire respondent.

APPENDIX C

Modified Version of the Job Diagnostic Survey

USAF SURVEY CONTROL NUMBER 78-94
(Expires 1 July 1978)

WORK ATTITUDES QUESTIONNAIRE -- Phase II

Student Identification: (last 4 digits SSN) [ ]

Part One

We would like your opinion of the task you just worked on. Please try to think only about the task of assembling the Erector set parts, other people in the room with you, and the leader (AFIT grad student).

Insert the number which best represents how you feel about that item with regard to the Erector set exercise.

How accurate is the statement in describing the Erector set task?

1 -------	2 -------	3 -------	4 -------	5 ------	6 ------	7
Very Inaccurate	Mostly Inaccurate	Slightly Inaccurate	Uncertain	Slightly Accurate	Mostly Accurate	Very Accurate

____ 1. The task required me to use a number of complex or high-level skills.

____ 2. The task was arranged so that I did NOT have a chance to do an entire piece of work from beginning to end.

____ 3. Just doing the work required by the task provided many chances for me to figure out how well I was doing.

____ 4. The job was quite simple and repetitive.

____ 5. The leader and co-workers on this task almost never gave me any "feedback" about how well I was doing on my Erector models.

____ 6. This task is one where a lot of other people could be affected by how well I performed.

____ 7. This task denied me any chance to use my personal initiative or judgment in carrying out the work.

____ 8. The leader often let me know how well I was performing.

____ 9. The task provided me the chance to completely finish the pieces of work I had begun.

____ 10. The task itself provided very few clues about whether or not I was performing well.

____ 11. The task gave me considerable opportunity for independence and freedom in how I did the work.

____ 12. The task itself was NOT very significant or important in the broader scheme of things.

APPENDIX D

Modified Version of the Job Descriptive Index

Part Two

In this section we want you to describe your reactions to the Erector set task you have just worked on.

Below are listed a number of words which can be used to describe work in general. In the blank beside each word write:

__Y__ for "Yes" if it describes the Erector set task

__N__ for "No" if it does NOT describe it

__?__ if you cannot decide

Words to Describe the Task

_____ Fascinating

_____ Routine

_____ Satisfying

_____ Boring

_____ Good

_____ Creative

_____ Respected

_____ Hot

_____ Pleasant

_____ Useful

_____ Tiresome

_____ Healthful

_____ Challenging

_____ On your feet

_____ Frustrating

_____ Simple

_____ Endless

_____ Gives sense of accomplishment

Part Three

In this section we want you to describe your reactions to the way in which the AFIT grad sutdent(leader) conducted the Erector set task.

Below are listed a number of words which can be used to describe supervisors in general. In the blank beside each word write:

__Y__ for "Yes" if it describes the leader

__N__ for "No" if it does NOT describe him

__?__ if you cannot decide

Words to Describe the Leader

_____ Asks my advice

_____ Hard to please

_____ Impolite

_____ Praises good work

_____ Tactful

_____ Influential

_____ Up-to-date

_____ Doesn't supervise enough

_____ Quick tempered

_____ Tells me where I stand

_____ Annoying

_____ Stubborn

_____ Knows job well

_____ Bad

_____ Intelligent

_____ Leaves me on my own

_____ Around when needed

_____ Lazy

APPENDIX E

Key to Interpretation of the Modified Job Diagnostic Survey

Core Dimension	Question Number (Appendix C) (R = reverse scoring)
Skill Variety	1, 4R
Task Identity	2R, 9
Task Significance	6, 12R
Autonomy	7R, 11
Feedback/Job	3, 10R

APPENDIX F

Performance Score Sheet

Student I.D. _____

____ Enriched ____ Group

____ Unenriched ____ Individual

PRODUCTIVITY COUNT: _____

QUALITY SCORE:

Criteria	Score
1. Tightness of nut/bolt connections?	____
2. Correctness of model--bolts in correct holes?	____
3. Is base plate level?	____
4. Bolts facing properly?	____
5. Supports perpendicular?	____
6. Platforms, angle-irons facing properly?	____
7. Does the model work?	____
8. Is the model identical to the sample?	____
TOTAL	____

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